



**Phillips Lytle LLP**

December 18, 2017

**Via Federal Express**

Village of Trumansburg Planning Board  
c/o Mr. Rick Geiger, Chairman  
Village Hall  
56 E. Main Street  
Trumansburg, NY 14886

Re: **Supplemental Information - - Application for Preliminary Site Plan Review & Major Subdivision Review - - Ithaca Neighborhood Housing Services and Sundial Property Development, LLC/Claudia Brenners' Proposed Project at 46 South Street in the Village of Trumansburg, New York**

Dear Chairman Geiger and Members of the Planning Board:

As you know, we represent Ithaca Neighborhood Housing Services ("INHS") in connection with the project at 46 South Street ("Project"), which involves the proposed development of a residential/mixed-use/mixed-income residential project on a nineteen (19) acre parcel of property located at 46 South Street in the Village of Trumansburg, New York ("Site").

The above-referenced application was filed on December 14, 2017. The application indicated that we would be submitting to the Planning Board, under separate cover, the stormwater system calculations once they were complete. As such, enclosed please find one (1) original and eight (8) copies of *Exhibit N, Stormwater System Calculations*, to be included as part of the above-referenced application.

We look forward to appearing before the Planning Board at its regularly scheduled meeting on Thursday, January 25, 2018 to discuss this application in more detail. In the meantime, if you have any questions, please do not hesitate to contact the undersigned.

Very truly yours

Phillips Lytle LLP

By   
Joseph C. Smith

Enclosure

cc: Matt Johnston, Village Planner  
Joseph L. Bowes, Director of Real Estate Development, INHS  
Alena Fast, Real Estate Developer, INHS  
Claudia Brenner, Architect

Doc #01-3088422.1

JOSEPH C. SMITH

DIRECT 716 847 5407 JSMITH@PHILLIPSLYTLE.COM  
ATTORNEYS AT LAW

ONE CANALSIDE 125 MAIN STREET BUFFALO, NY 14203-2887 PHONE 716 847 8400 FAX 716 852 6100

NEW YORK: ALBANY, BUFFALO, CHAUTAUQUA, GARDEN CITY, NEW YORK, ROCHESTER | WASHINGTON, DC | CANADA: WATERLOO REGION | PHILLIPSLYTLE.COM

# 46 South Street

## *Preliminary Stormwater Calculations*

---

### *Summary*

*Village of Trumansburg  
Tompkins County, New York*

### *Prepared for:*

*Ithaca Neighborhood Housing Services &  
Sundial Property Development LLC  
115 West Clinton Street  
Ithaca, NY 14850*

### *Prepared by:*



*T.G. Miller P.C.  
203 North Aurora Street  
Ithaca, New York 14850  
(607) 272-6477*

*December 13, 2017*

## TABLE OF CONTENTS

<b>PROJECT DESCRIPTION</b>	<b>1</b>
PURPOSE AND EXTENT OF PROPOSED DEVELOPMENT	1
PROJECT DISTURBANCE AREA	1
DESCRIPTION AND LIMITATIONS OF ON-SITE SOILS	1
<b>POST-CONSTRUCTION STORMWATER MANAGEMENT</b>	<b>1</b>
EXISTING CONDITIONS	1
FUTURE CONDITIONS	2
WATER QUALITY CONTROLS	3
RUNOFF REDUCTION VOLUME	4
WATER QUANTITY CONTROLS	5
PRACTICE SIZING	7
<i>BIORETENTION FILTER</i>	7
<i>RAIN GARDENS</i>	8
<i>HYDRODYNAMIC SEPARATOR</i>	8
<i>STORMWATER WETLANDS</i>	8
<i>UNDERGROUND DETENTION SYSTEM</i>	8
<b>FIGURES</b>	
EXISTING WATERSHED BOUNDARIES	SHEET 1 OF 2
PROPOSED WATERSHED BOUNDARIES	SHEET 2 OF 2
<b>ATTACHMENTS</b>	
WATER QUALITY, RRV CALCS	
USDA SOILS MAP	
HYDROCAD – EXISTING CALCS	
HYDROCAD – PROPOSED CALCS	

## PROJECT DESCRIPTION

### Purpose and Extent of Proposed Development

The 46 South Street project is located in the Village of Trumansburg, Tompkins County, New York (Tax Map Parcels 9.-1-2 & 8.-3-2.2). The project includes the consolidation of the two parcels then the subdivision of the 19.115 acres into 15 parcels that will include market rate for-sale units, affordable for-sale townhomes, affordable rental townhomes, rental apartments and a nursery school. The project will also include various amenities such roads, parking and walkways.

The stormwater management objectives for the project focus on treatment of runoff from the post-developed site. As a townhome and multifamily residential property disturbing greater than one acre of land, a full Stormwater Pollution Prevention Plan (SWPPP) is required, including both temporary erosion controls and permanent stormwater management practices under the regulations of the Village of Trumansburg and New York State Department of Environmental Conservation (DEC). Stormwater management objectives for the site include:

- Providing water quality treatment by means of stormwater wetlands, a bioretention filter, and rain gardens.
- Provide Runoff Reduction by means of rain gardens and a bioretention filter.
- Providing stormwater detention to meet DEC's standards for mitigating runoff from the 1-, 10-, and 100-year storm events.

### Project Disturbance Area

Total Disturbed Area:	14.91 acres
Existing Impervious Area:	0.00 acres
Proposed Impervious Area:	4.63 acres
Increase in Impervious Area:	4.63 acres

### Description and Limitations of On-Site Soils

On-site soils consist of Howard gravelly loam (33.7%), Lansing gravelly silt loam (7.6%), Ovid silt loam (13.7%) and Rhinebeck silt loam (45.0%) based on the USDA Soil Surveys of Tompkins County. Based upon the classification of soils defined by the Natural Resource Conservation Service, the site contains 33% HSG "A" 8% HSG "B" and 59% HSG "D" soils.

A geotechnical investigation to determine the soil types and properties for the on-site soils was conducted by the geotechnical consultant, Empire Geo-Services Inc., in August 2017. The report shows higher groundwater in the areas associated with "D" soils in the USDA report.

## POST-CONSTRUCTION STORMWATER MANAGEMENT

### Existing Conditions

The project site is best characterized as undeveloped land, and will disturb approximately 14.91 acres. 100% of the existing site cover is pervious.

There are two watersheds in the vicinity of the project site that will be impacted by the proposed project. The western watershed (WS#1) has been divided into two subareas (WS#1A and WS#1B).



Watershed #1A drains in a southeasterly direction to existing Wetland A, which is the point of analysis. Watershed #1B picks up overflow from Watershed 1A and a majority of the site and drains in a southeasterly direction to the point of analysis.

The eastern watershed (WS#2) has been divided into two subareas (WS#2A and WS#2B). Watershed #2A drains the northeastern portion of the site to Wetland C then north of the Connor property to the point of analysis. (See Sheet 1 of 2 – Existing Watershed Boundaries) Watershed #2B drains mostly off-site properties and a small portion of the site in a northeasterly direction to South Street where a catch basin and a couple of yard inlets, combined with 6" and 18" piping, collect the runoff. The point of analysis is the end of the existing 18" CMP that discharges to the roadside swale north of the Connor property.

**TABLE 1. HYDROLOGIC DATA FOR EXISTING CONDITIONS**

<b>Watershed</b>	<b>Drainage Area (Acres)</b>	<b>Curve Number</b>	<b>Time of Concentration (min)</b>
1A	11.31	75	20.3
1B	14.15	67	25.5
2A	2.59	39	29.2
2B	4.87	62	15.3

#### **Future Conditions**

Development of the site will include the construction of market rate for-sale units, affordable for-sale townhomes, affordable rental townhomes, rental apartments and a nursery school. The project will also include various amenities such roads, parking and walkways. The project will disturb approximately 14.91 acres and the footprint of new impervious surfaces will increase by approximately 4.63 acres.

The stormwater strategy will utilize stormwater wetlands, a bioretention filter, and rain gardens to treat the water quality volume. The filter practice is shown in the only location that was practicable, due to flat site grades. Whatever water quality volume is not provided by the bioretention filter and rain gardens will be provided in the stormwater wetlands. Detention for the 1-, 10- and 100-year storm events in Watershed #1 will be provided in two stormwater wetlands. Watershed #2 will have a below ground detention system to provide storage for the 1-, 10- and 100-year storm events. (See Sheet 2 of 2 – Proposed Watershed Boundaries)

**TABLE 2. HYDROLOGIC DATA FOR FUTURE CONDITIONS**

<b>Watershed</b>	<b>Drainage Area (Acres)</b>	<b>Curve Number</b>	<b>Time of Concentration (min)</b>
1A	8.97	75	20.3
1B	15.65	78	16.0
1C	1.00	57	13.9
1D	1.12	79	7.4
2A	2.38	40	23.8
2B	4.21	66	15.3
2C	0.17	94	6.0

### Water Quality Controls

The water quality strategy is designed to improve water quality by capturing and treating 90% of the average annual stormwater runoff volume. The required water quality volume is calculated from the following equation:

$$WQ_v = P * (0.05 + 0.009 * I) * A / 12$$

Where:

$$\begin{aligned} P &= 90\% \text{ rainfall event (inches)} \\ &= 1.00 \text{ inches (Ithaca, NY)} \\ R_v &= (0.05 + 0.009 * I) \text{ (minimum allowed value = 0.20)} \\ I &= \text{Imperviousness (\%)} \\ A &= \text{Drainage Area (s.f.)} \\ &= 19.12 \text{ acres (site acreage was used to determine requirements)} \end{aligned}$$

$$\begin{aligned} \text{Therefore: } I &= 4.63 \text{ acres} / 19.12 \text{ acres} \\ &= 24\% \end{aligned}$$

$$\begin{aligned} R_v &= (0.05 + 0.009 * 24\%) \\ &= 0.27 \end{aligned}$$

$$\begin{aligned} \text{Required } WQ_v &= 1.00'' * 0.27 * 19.12 / 12 \\ &= 0.427 \text{ acre feet} \\ &= 18,595 \text{ cubic feet} \end{aligned}$$

The project plans to utilize both rooftop disconnection and tree planting credits towards the water quality and runoff reduction requirements. These credits are applied by recalculating the  $WQ_v$  and  $RR_v$  requirements while counting the disconnected rooftop portions and up to 100 square feet of impervious cover per tree as pervious surfaces.

**Rooftop disconnections:** Most of the buildings were counted towards this credit. The large multifamily building, half of the nursery, and half of the two buildings adjacent to existing Wetland "A" were not counted, as their roof runoff is unable to be directed to vegetated areas that meet the NYSDEC requirements. 0.74 acres of roofs are counted in this credit.

**Tree Planting:** Only trees along roads, having canopies greater than 16 feet in diameter were counted for this credit. If the tree canopies did not cover adequate impervious cover, they were not counted. 205 trees were counted, with 100 square feet of impervious cover being credited per tree (for a total of 0.47 acres).

The recalculated water quality volume is as shown as follows:

$$\begin{aligned} P &= 90\% \text{ rainfall event (inches)} \\ &= 1.00 \text{ inches (Ithaca, NY)} \\ R_v &= (0.05 + 0.009 * I) \text{ (minimum allowed value = 0.20)} \\ I &= \text{Imperviousness (\%)} \\ A &= \text{Drainage Area (s.f.)} \\ &= 19.12 \text{ acres (site acreage was used to determine requirements)} \end{aligned}$$

$$\begin{aligned}
 \text{Therefore: } I &= (4.63 \text{ acres} - 0.74 \text{ acres} - 0.47 \text{ acres}) / 19.12 \text{ acres} \\
 &= 18\% \\
 R_v &= (0.05 + 0.009 * 18\%) \\
 &= 0.211 \\
 \text{Required } WQ_v &= 1.00'' * 0.211 * 19.12 / 12 \\
 &= 0.336 \text{ acre feet} \\
 &= 14,645 \text{ cubic feet}
 \end{aligned}$$

### Runoff Reduction Volume

Runoff reduction can be achieved by infiltration, groundwater recharge, recycling, or evaporation/evapotranspiration of 100 percent of the post-development water quality volumes to replicate pre-development hydrology. This can be achieved by maintaining pre-construction infiltration, peak runoff flows, discharge volumes, and minimizing concentrated flows through the use of runoff control techniques that will provide treatment in a distributed manner before runoff reaches the collection system. This requirement can be accomplished by application of on-site green infrastructure techniques, standard stormwater management practices with runoff reduction capacity, and good operation and maintenance.

In the case of this project high ground water, low hydrologic soil ratings and extremely flat topography preclude the installation of most green infrastructure practices. As a result of these physical limitations, 100% runoff reduction of the water quality volume cannot be achieved. Projects that cannot achieve runoff reductions to pre-construction conditions must, at a minimum, reduce a percentage of the runoff from impervious areas to be constructed on the site. The percent reduction is based on the Hydrologic Soil Groups (HSG) of the site. The minimum runoff reduction volume required is calculated using the following equation:

$$\text{Min RRv} = [(P) (R_v^*) (A_i)] / 12$$

Where:

$$\begin{aligned}
 P &= 90\% \text{ rainfall event (inches)} \\
 &= 1.00 \text{ inches (Ithaca, NY)} \\
 R_v^* &= 0.05 + 0.009(I) \text{ Where } I \text{ is } 100\% \text{ impervious} \\
 A_i &= (S)(A_{ic}) \\
 (A_{ic}) &= \text{Total area of impervious cover (acres)} \\
 S &= \text{HSG Specific Reduction Factor} \\
 &= 0.55 \text{ for HSG "A" Soils (32\% of site)} \\
 &= 0.40 \text{ for HSG "B" Soils (8\% of site)} \\
 &= 0.20 \text{ for HSG "D" Soils (60\% of site)}
 \end{aligned}$$

$$\begin{aligned}
 S &= 32\% * 0.55 + 8\% * 0.40 + 60\% * 0.20 \\
 &= 0.33
 \end{aligned}$$

$$\begin{aligned}
 A_{ic} &= 0.33 * 3.42 \\
 &= 1.13 \text{ acres to be treated}
 \end{aligned}$$

$$\begin{aligned}
 \text{Min RRv} &= (1.00'' * [0.05 + 0.009(100)] * (0.33 * 3.42)) / 12 \\
 &= 0.089 \text{ ac-ft (3,875 cubic feet)}
 \end{aligned}$$

**Water Quantity Controls**

The water quantity practice is designed to reduce peak discharges for the 1, 10, and 100-year storms to below pre-developed rates at the point of analysis. In Watershed 1A some small storage will be continue to be provided in existing Wetland "A." However, Watersheds #1A and #1B will both drain to the proposed Stormwater Wetlands to attenuate post-developed peak flows. Watershed #1C will be mitigated by means of a separate Stormwater Wetland, and Watershed #1D is not captured and sheet drains off the site.

Watershed #2C contains the South Street drive, the majority of which will be captured by underground detention and then treated by a hydrodynamic separator unit. Watersheds #2A and #2C will remain largely unchanged, with some small areas of woods and meadow being converted to lawn prior to draining off of the site.

Table 3 summarizes resulting peak discharge rates from within each of these watersheds.

<b>TABLE 3. HYDROLOGIC MODELING RESULTS</b>						
	Runoff Volume (acre-feet)			Peak Rate of Runoff (cfs)		
	1-yr	10-yr	100-yr	1-yr	10-yr	100-yr
<b>Pre-Developed</b>						
WS #1A (Existing Wetland)	0.233	0.955	2.571	1.69	13.76	37.06
WS #1B	0.154	0.799	2.483	0.87	8.86	30.82
<b>WS #1 (POA)</b>	<b>0.381</b>	<b>1.738</b>	<b>5.022</b>	<b>2.13</b>	<b>16.79</b>	<b>46.33</b>
<b>WS #2A</b>	<b>0.000</b>	<b>0.000</b>	<b>0.063</b>	<b>0.00</b>	<b>0.00</b>	<b>0.26</b>
<b>WS #2B</b>	<b>0.024</b>	<b>0.193</b>	<b>0.697</b>	<b>0.07</b>	<b>2.61</b>	<b>11.39</b>
<b>Post-Developed: Controlled (increase over pre-developed)</b>						
WS #1A (Existing Wetland)	0.173 (-0.060)	0.745 (-0.210)	2.026 (-0.545)	1.05 (-0.64)	10.62 (-3.14)	24.57 (-12.49)
WS #1B	0.532 (+0.378)	1.650 (+0.851)	4.026 (+1.543)	8.00 (+7.13)	26.81 (+17.95)	64.95 (+34.13)
Stormwater Wetland (WS #1A & 1B)	0.181	0.402	4.028	0.31	0.73	27.46
Wetland #2 (WS#1C)	1.000	0.016	0.086	0.00	0.03	0.15
WS #1D	0.041	0.124	0.298	0.89	2.73	6.35
<b>WS #1 (POA)</b>	<b>0.223</b> <b>(-0.158)</b>	<b>0.542</b> <b>(-1.196)</b>	<b>4.412</b> <b>(-0.610)</b>	<b>0.90</b> <b>(-1.23)</b>	<b>2.92</b> <b>(-13.87)</b>	<b>28.28</b> <b>(-18.05)</b>
<b>WS #2A</b>	<b>0.000</b> <b>(0.000)</b>	<b>0.000</b> <b>(0.000)</b>	<b>0.067</b> <b>(+0.004)</b>	<b>0.00</b> <b>(0.00)</b>	<b>0.00</b> <b>(0.00)</b>	<b>0.35</b> <b>(+0.09)</b>
WS #2B	0.040 (+0.016)	0.224 (+0.031)	0.713 (+0.016)	0.26 (+0.19)	3.36 (+0.75)	11.81 (+0.42)
WS #2C (Detention)	0.018	0.036	0.066	0.15	0.22	0.30
<b>WS #2B/C (POA)</b>	<b>0.058</b> <b>(+0.034)</b>	<b>0.259</b> <b>(+0.066)</b>	<b>0.779</b> <b>(+0.082)</b>	<b>0.41</b> <b>(+0.34)</b>	<b>3.58</b> <b>(+0.97)</b>	<b>12.11</b> <b>(+0.72)</b>

As can be seen in Table 3, there will be slight increase in some of the rates of runoff for Watersheds #2A and #2B/2C. This is largely due to the conversion of some existing meadow and forest to lawn. The site grading was modified to decrease the acreage of property that was draining to South Street, but some areas couldn't be captured due to site topography. The only impervious area that will drain untreated towards South Street is 0.02 acres of the South Street driveway apron. All other impervious covers will be captured and treated before leaving the site.

## Practice Sizing

### **Bioretention Filter**

The filter will capture and treat runoff from a portion of Watershed #1B. The filter is sized using Darcy's Law as presented in the New York State Stormwater Management Design Manual, using the following equation:

$$A_f = WQ_v (d_f) / [(k)(T)(d_f + h_f)]$$

Where:

$$\begin{aligned} A_f &= \text{Filter Area (sf)} \\ d_f &= \text{Filter Depth (feet)} = 2.0 \text{ feet} \\ h_f &= \text{Average Head Above Filter (feet)} = 0.5 \text{ feet} \\ T_f &= \text{Filtering Time (days)} = 2 \text{ days} \\ k &= \text{Soil Permeability (ft/day)} = 0.5 \text{ ft/day} \\ WQ_v &= \text{Water Quality Volume (cf)} \end{aligned}$$

Therefore:

$$\begin{aligned} P &= 90\% \text{ rainfall event (inches)} \\ &= 1.00 \text{ inches (Ithaca, NY)} \\ R_v &= (0.05 + 0.009 * I) \text{ (minimum allowed value} = 0.20) \\ I &= \text{Imperviousness (\%)} \\ A &= \text{Drainage Area (s.f.)} \\ &= 1.53 \text{ acres (site acreage was used to determine requirements)} \end{aligned}$$

$$\begin{aligned} \text{Therefore: } I &= (1.13 \text{ acres}) / 1.53 \text{ acres} \\ &= 74\% \end{aligned}$$

$$\begin{aligned} \text{Required } WQ_v &= 1.00 * (0.05 + 0.009 * 74\%) * 1.53 / 12 \\ &= 0.091 \text{ acre feet} \\ &= 3,970 \text{ cubic feet} \end{aligned}$$

Therefore:

$$\begin{aligned} A_f &= 3,529 * 2.0 / [(0.5)(2)(2 + 0.5)] \\ A_f &= 3,529 \text{ square feet } \textbf{required} \end{aligned}$$

As bioretention filters in "C/D" soils only provide 40% RR<sub>v</sub>, the filter will be oversized by 2.5 to provide enough surface area to provide 100% RR<sub>v</sub> for the drainage area.

$$\begin{aligned} A_f &= 2.5 * 3,529 = 8,822 \text{ square feet } \textbf{required} \\ A_f &= 9,065 \text{ square feet } \textbf{provided} \end{aligned}$$

The oversizing of the filter allows for 100% of the WQ<sub>v</sub> treated to be counted towards runoff reduction. As the filter watershed contains 1.13 acres of impervious cover, it meets the minimum RR<sub>v</sub> area and volume requirements.

***Rain Gardens***

Several rain gardens are being proposed on INHS properties. This will be small rain gardens, with a 12-inch deep soil cross-section. They will capture and treat runoff from some of the driveways, and help provide extra WQv and RRv.

***Hydrodynamic Separator***

A hydrodynamic separator unit will be used to treat runoff from the South Street drive, before it enters the existing South Street storm sewer.

***Stormwater Wetlands***

The wetland practices are designed to mitigate stormwater discharges for the 1-, 10- and 100-year storm events, while provided WQv treatment for areas not treated by the bioretention filter. The large stormwater wetland that treats WS#1B will have two outlet control structures, with three 18-inch culverts that discharge to existing Wetland "F" which is the Point of Analysis for Watershed #1. The smaller stormwater wetland practice will have a single outlet control structure with one 8-inch culvert that discharges to Wetland "F." Both practices have 3-inch orifices to provide Chancel Protection.

The wetland practices were sized using HydroCAD, as can be seen in the attached calculations.

***Underground Detention System***

To manage runoff from the South Street drive, underground pipe storage is being proposed to mitigate the 1-, 10- and 100-year storm events. The piping has been sized in HydroCAD and includes and outlet control structure with a 3-inch orifice for channel protection and a weir to detain water in the upstream pipes.



**TMA**  
LANDSCAPE ARCHITECTS  
1001 W. 14th St., 1st Fl.  
Ithaca, NY 14850  
P: 607.273.1800 F: 607.273.0475

**HOLT**  
ARCHITECTS  
Architecture  
Planning  
Interior Design  
619 W. State Street  
Ithaca, NY 14850  
P: 607.273.1800 F: 607.273.0475

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX

**T.G. MILLER, P.C.**  
ENGINEERS AND SURVEYORS  
203 NORTH AURORA STREET  
ITHACA, NEW YORK 14850  
607-273-6477 FAX  
607-273-8332 FAX





Architecture  
Planning  
Interior Design  
619 W State Street  
Ithaca NY 14850  
P 607.273.7000 F 607.273.0475

**T.G. MILLER, P.C.**  
LANDSCAPE ARCHITECT  
203 NORTH ARCADE STREET  
ITHACA, NEW YORK 14850  
607-273-8477 fax  
607-273-8332 fax

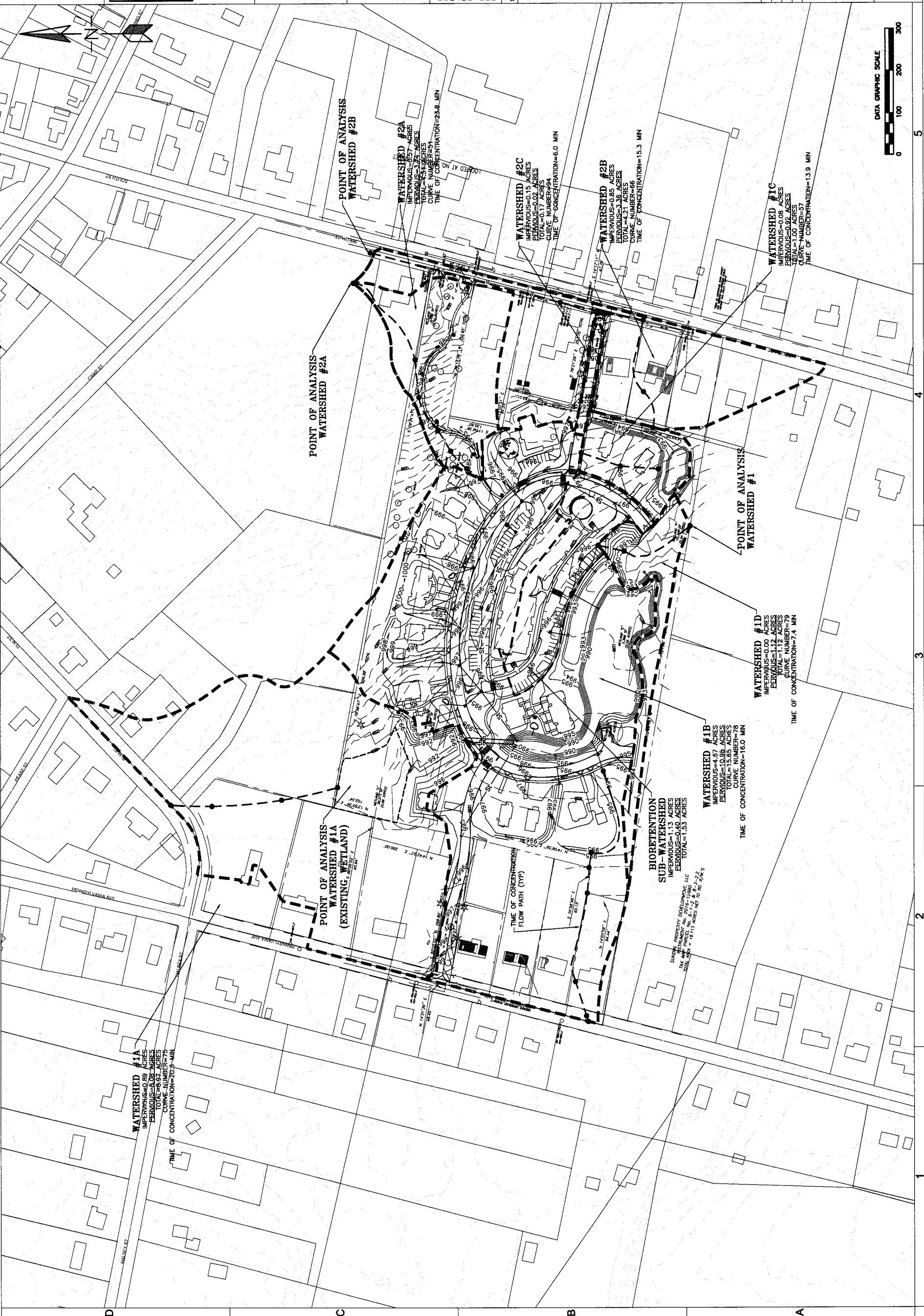
IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED LANDSCAPE ARCHITECT, TO PREPARE OR SIGN THIS DOCUMENT. ANY PERSON WHO VIOLATES THIS DOCUMENT IS REQUIRED BY LAW TO AFFIX HIS OR HER SEAL AND THE SIGNATURE OF A LICENSED LANDSCAPE ARCHITECT TO ANY DOCUMENT. ANY PERSON WHO VIOLATES THIS DOCUMENT IS SUBJECT TO THE DISCIPLINARY ACTION OF THE BOARD OF LANDSCAPE ARCHITECTS.

CONTRACT NO. 044  
TOWN OF ITHACA, NEW YORK

Ithaca Neighborhood Housing Services & Sundial Property Development LLC  
**46 South Street**  
Trumansburg, New York

DATE: 12/13/2017  
PROJECT: 17000  
DRAWN BY: RK  
CHECKED:

PROPOSED  
WATERSHED  
BOUNDARIES



---

### Site Water Quality Volume

---

$$WQ_v = P * R_v * A / 12$$

Where:  $R_v = (0.05 + 0.009 * I)$  (min 0.20)

Impervious Cover (acres):

Site Area (acres):

Imperviousness, I (%):

WQ Storm, P (in):

$R_v$ :

WQ Volume Required (acre-feet):

WQ Volume Required (cubic feet):

---

### Site Runoff Reduction Calculations

---

$$RR_v = (P) (R_v^*) (A_i) / 12$$

Where:  $A_i = (S) (A_{ic})$

Impervious Cover (acres),  $A_{ic}$ :

WQ Storm, P:

HSG Reduction Factor, S:

Impervious Cover targeted for  $RR_v$ ,  $A_i$ :

$R_v^*$ :

Minimum  $RR_v$  (acre-feet):

Minimum  $RR_v$  (cubic feet):

HSG:

- A 6.15 Ac (32%)
- B 1.55 Ac (8%)
- C 0.00 Ac (0%)
- D 11.42 Ac (60%)

---

### Site Water Quality Volume Recalculated After Rooftop Disconnection

---

$$WQ_v = P * R_v * A / 12$$

Where:  $R_v = (0.05 + 0.009 * I) (\text{min } 0.20)$

Impervious Cover (acres):  minus 0.74 Roof Disconnect

Drainage Area (acres):

Imperviousness, I (%):

WQ Storm, P (in):

Rv:

WQ Volume Required (acre-feet):

WQ Volume Required (cubic feet):

---

### Site Runoff Reduction Calculations Recalculated After Rooftop Disconnection

---

$$RR_v = (P) (R_v^*) (A_i) / 12$$

Where:  $A_i = (S) (A_{ic})$

Impervious Cover (acres),  $A_{ic}$ :

WQ Storm, P:

HSG Reduction Factor, S:

Impervious Cover targeted for  $RR_v$ ,  $A_i$ :

$R_v^*$ :

Minimum  $RR_v$  (acre-feet):

Minimum  $RR_v$  (cubic feet):

HSG:

A	6.15 Ac	(32%)
B	1.55 Ac	(8%)
C	0.00 Ac	(0%)
D	11.42 Ac	(60%)

---

### Site Water Quality Volume Recalculated After Accounting for Tree Plantings

---

$$WQv = P * Rv * A / 12$$

$$\text{Where: } Rv = (0.05 + 0.009 * I) (\text{min } 0.20)$$

Impervious Cover (acres):	3.42	minus 205 trees x 100sf (0.47 acres)
Drainage Area (acres):	19.12	
Imperviousness, I (%):	18%	
WQ Storm, P (in):	1.0	
Rv:	0.211	
WQ Volume Required (acre-feet):	0.336	
WQ Volume Required (cubic feet):	14,645	

---

### Site Runoff Reduction Calculations After Accounting for Tree Plantings

---

$$RRv = (P) (Rv^*) (Ai) / 12$$

$$\text{Where: } Ai = (S) (Aic)$$

Impervious Cover (acres), Aic:	3.42	
WQ Storm, P:	1.0	
HSG Reduction Factor, S:	0.33	
Impervious Cover targeted for RRv, Ai:	1.12	
Rv*:	0.95	
Minimum RRv (acre-feet):	0.089	
Minimum RRv (cubic feet):	3,875	
HSG:		
A	6.15 Ac	(615%)
B	1.55 Ac	(155%)
C	0.00 Ac	(0%)
D	11.42 Ac	(1142%)

## Bioretention Filter Design

### Water Quality Volume

$$WQv = P * Rv * A / 12$$

Where:  $Rv = (0.05 + 0.009 * I)$

Impervious Cover (acres):

Drainage Area (acres):

Imperviousness, I (%):

WQ Storm, P (in):

Rv:

WQ Volume Required (acre-feet):

WQ Volume Required (cubic feet):

### Bioretention Filter Sizing

$$SA = WQv * d / [ k * (d + h) * t ]$$

WQv (cf):

Depth of Filter Media, d, (ft):

Coefficient of Permeability, k, (ft/day):

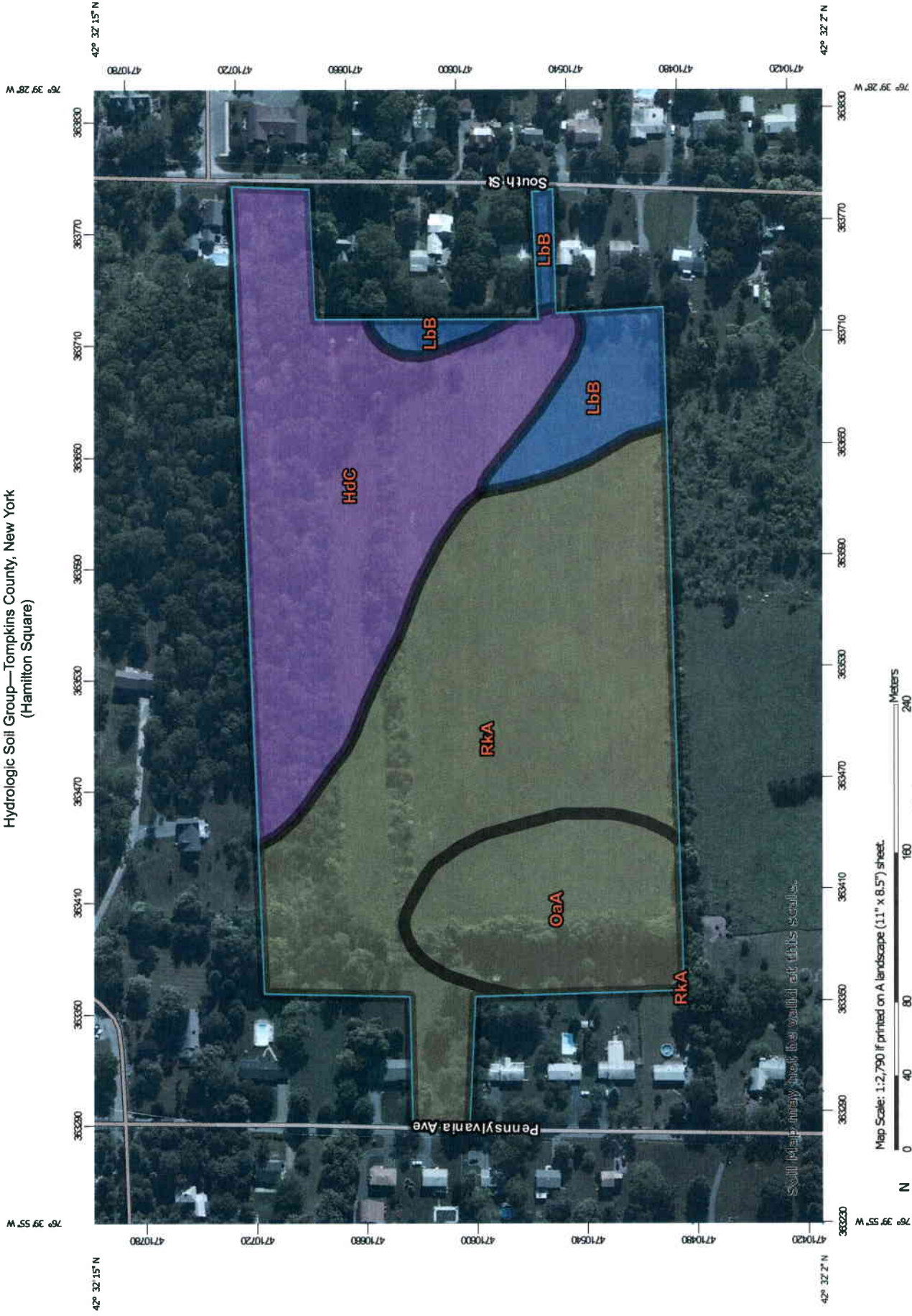
Average Height of Water above Filter Bed, h, (ft):

Filter Bed Drain Time, t, (days):

Surface Area Provided, SA, (sf):  8,822

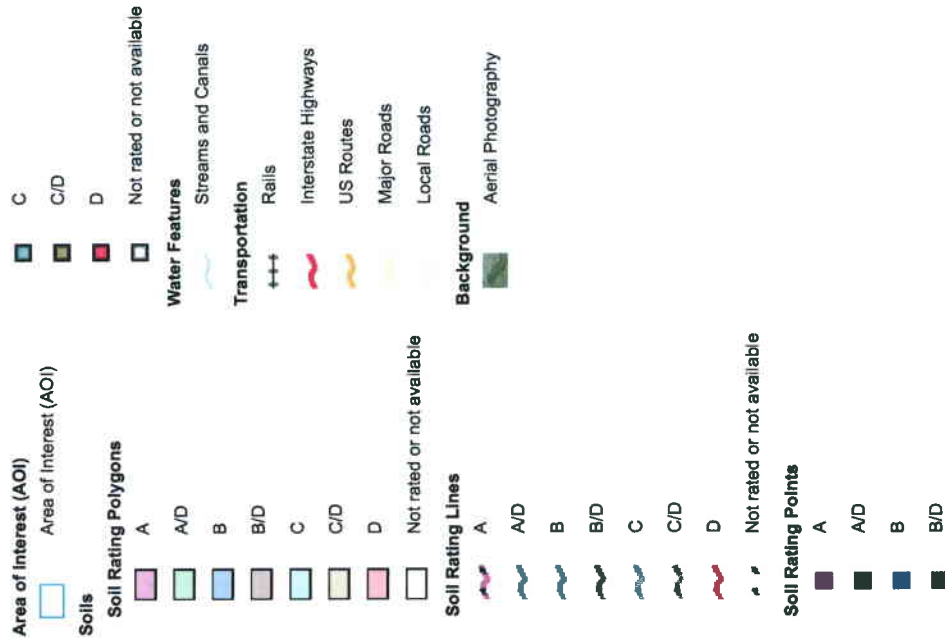
Surface Area Provided, (sf):  > Req'd, OK

Hydrologic Soil Group—Tompkins County, New York  
(Hamilton Square)





## MAP LEGEND



## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Tompkins County, New York

Survey Area Data: Version 11, Sep 24, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 2, 2010—Oct 8, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Tompkins County, New York (NY109)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HdC	Howard gravelly loam, 5 to 15 percent simple slopes	A	7.5	33.7%
LbB	Lansing gravelly silt loam, 3 to 8 percent slopes	B	1.7	7.6%
OaA	Ovid silt loam, 0 to 6 percent slopes	C/D	3.1	13.7%
RkA	Rhinebeck silt loam, 0 to 2 percent slopes	C/D	10.1	45.0%
<b>Totals for Area of Interest</b>			<b>22.4</b>	<b>100.0%</b>



## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

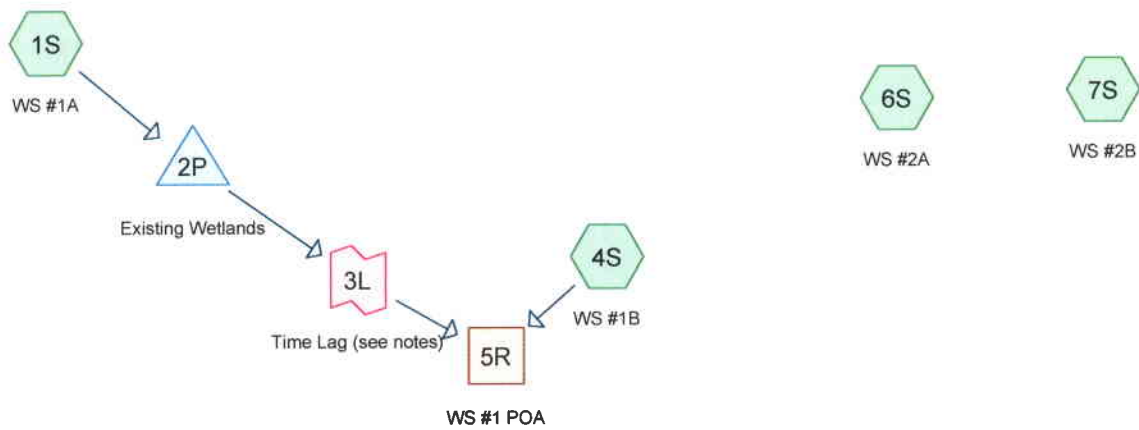
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



**Routing Diagram for Existing**

Prepared by Microsoft, Printed 12/14/2017

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 2

**Summary for Subcatchment 1S: WS #1A**

Runoff = 3.52 cfs @ 12.17 hrs, Volume= 0.296 af, Depth&gt; 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
1.120	98	Paved parking, HSG D
0.580	30	Woods, Good, HSG A
2.000	77	Woods, Good, HSG D
0.490	78	Meadow, non-grazed, HSG D
1.100	39	>75% Grass cover, Good, HSG A
6.020	80	>75% Grass cover, Good, HSG D
11.310	75	Weighted Average
10.190		90.10% Pervious Area
1.120		9.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			

**Existing**

Prepared by Microsoft

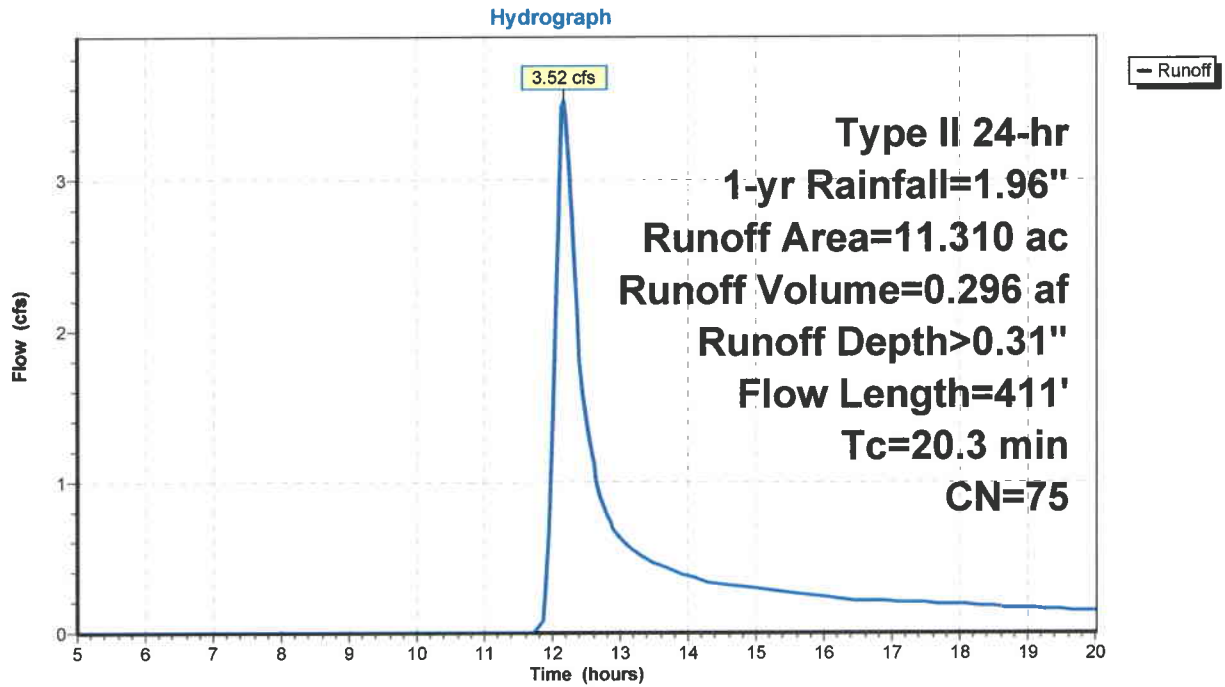
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 3

**Subcatchment 1S: WS #1A**



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 4

**Summary for Subcatchment 4S: WS #1B**

Runoff = 0.87 cfs @ 12.32 hrs, Volume= 0.154 af, Depth&gt; 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.100	98	Paved parking, HSG D
1.210	30	Woods, Good, HSG A
0.790	77	Woods, Good, HSG D
8.460	78	Meadow, non-grazed, HSG D
1.710	30	Meadow, non-grazed, HSG A
0.850	58	Meadow, non-grazed, HSG B
1.030	80	>75% Grass cover, Good, HSG D
14.150	67	Weighted Average
14.050		99.29% Pervious Area
0.100		0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.9	77	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.2	539	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.0	452	0.0060	1.25		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
25.5	1,386	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

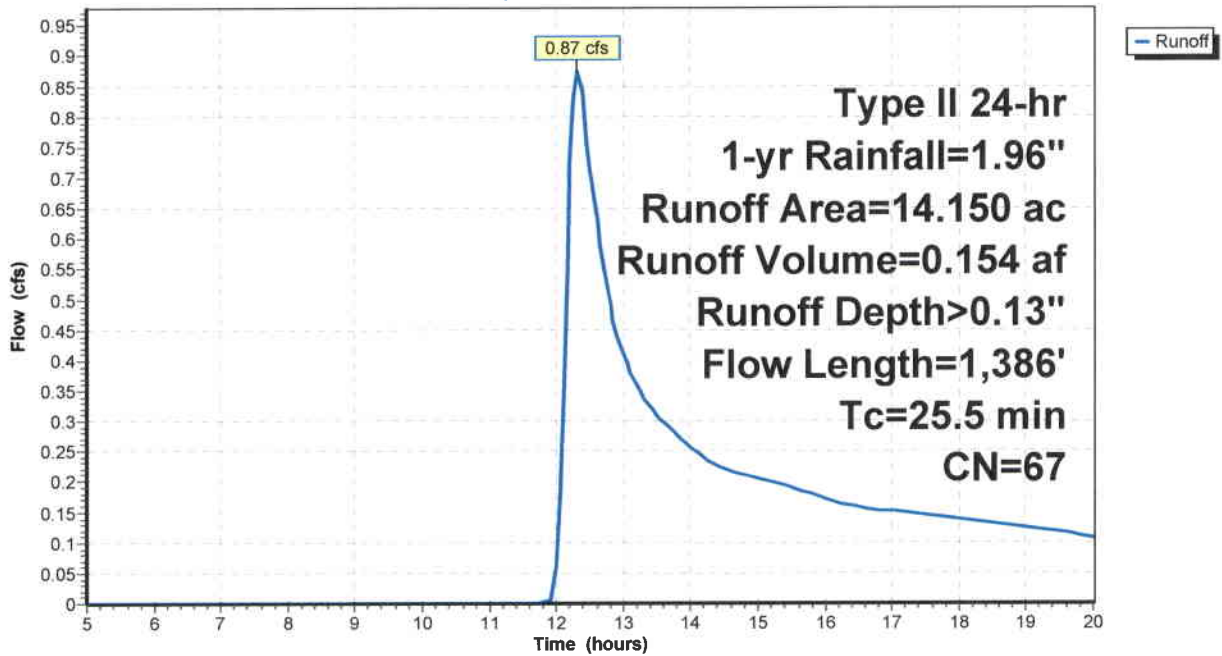
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 5

**Subcatchment 4S: WS #1B**

Hydrograph



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 6

**Summary for Subcatchment 6S: WS #2A**

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
1.220	30	Woods, Good, HSG A
1.100	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.590	39	Weighted Average
2.440		94.21% Pervious Area
0.150		5.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	43	0.0120	0.07		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 2.31"
11.8	57	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
2.0	151	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	32	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.2	531	Total			

**Existing**

Prepared by Microsoft

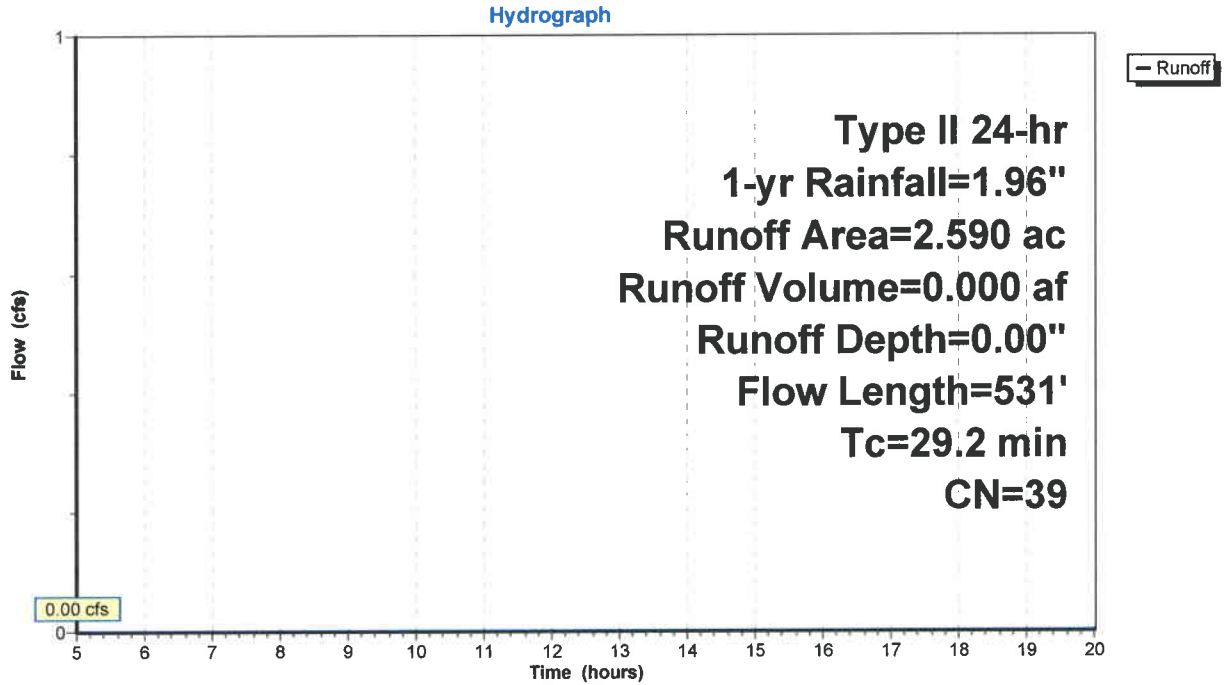
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 7

**Subcatchment 6S: WS #2A**





**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 8

**Summary for Subcatchment 7S: WS #2B**

Runoff = 0.07 cfs @ 12.51 hrs, Volume= 0.024 af, Depth&gt; 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.830	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.580	30	Meadow, non-grazed, HSG A
0.140	58	Meadow, non-grazed, HSG B
0.300	39	>75% Grass cover, Good, HSG A
2.920	61	>75% Grass cover, Good, HSG B
4.870	62	Weighted Average
4.040		82.96% Pervious Area
0.830		17.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

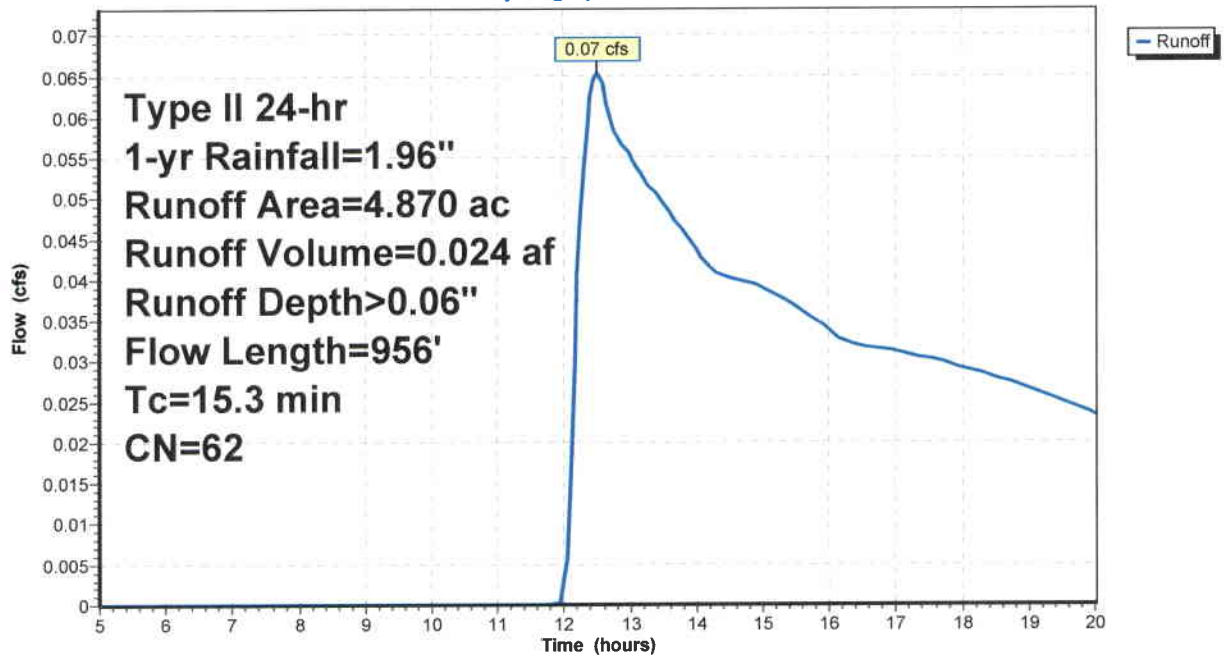
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 9

**Subcatchment 7S: WS #2B**

Hydrograph



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 10

### Summary for Reach 5R: WS #1 POA

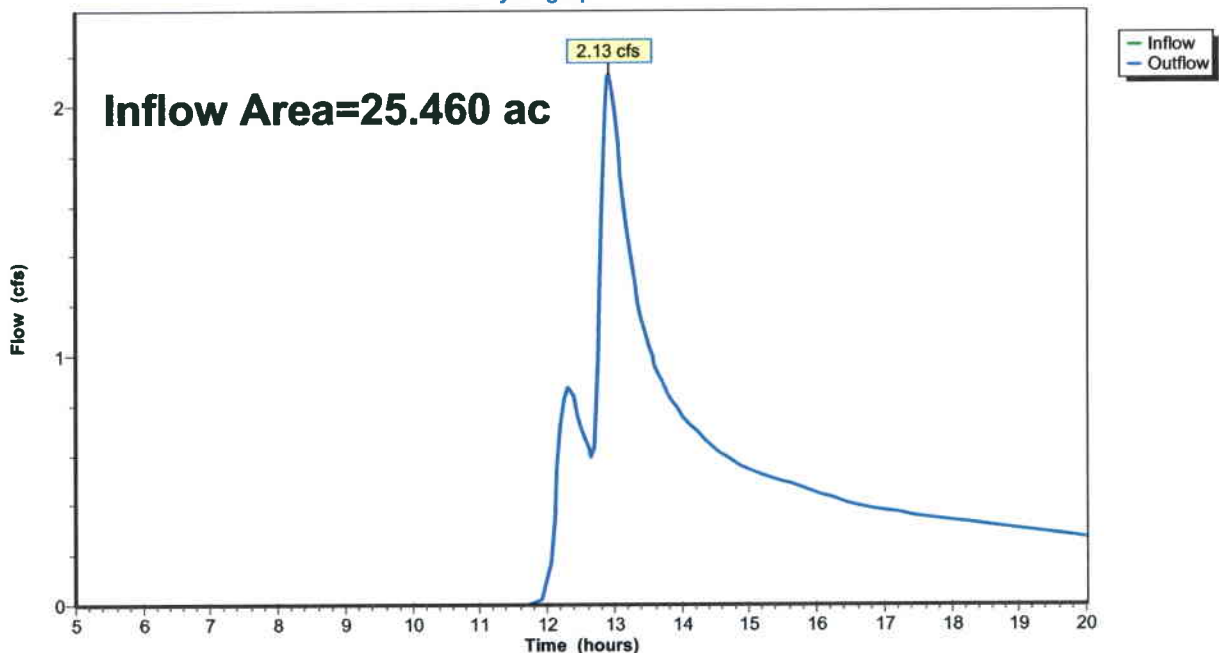
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 25.460 ac, 4.79% Impervious, Inflow Depth > 0.18" for 1-yr event  
Inflow = 2.13 cfs @ 12.92 hrs, Volume= 0.381 af  
Outflow = 2.13 cfs @ 12.92 hrs, Volume= 0.381 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: WS #1 POA

Hydrograph



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 11

**Summary for Pond 2P: Existing Wetlands**

Inflow Area = 11.310 ac, 9.90% Impervious, Inflow Depth > 0.31" for 1-yr event  
 Inflow = 3.52 cfs @ 12.17 hrs, Volume= 0.296 af  
**Outflow = 1.69 cfs @ 12.43 hrs, Volume= 0.233 af**, Atten= 52%, Lag= 15.7 min  
 Primary = 1.69 cfs @ 12.43 hrs, Volume= 0.233 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.53' @ 12.43 hrs Surf.Area= 13,368 sf Storage= 3,552 cf

Plug-Flow detention time= 99.1 min calculated for 0.232 af (79% of inflow)  
 Center-of-Mass det. time= 39.1 min ( 882.5 - 843.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	14,723 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	34,207	11,557	14,723

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -82.00 -58.00 0.00 51.00 Height (feet) 0.58 0.25 0.00 0.58

**Primary OutFlow** Max=1.68 cfs @ 12.43 hrs HW=992.53' TW=0.00' (Dynamic Tailwater)  
**1=Asymmetrical Weir** (Weir Controls 1.68 cfs @ 0.43 fps)

## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

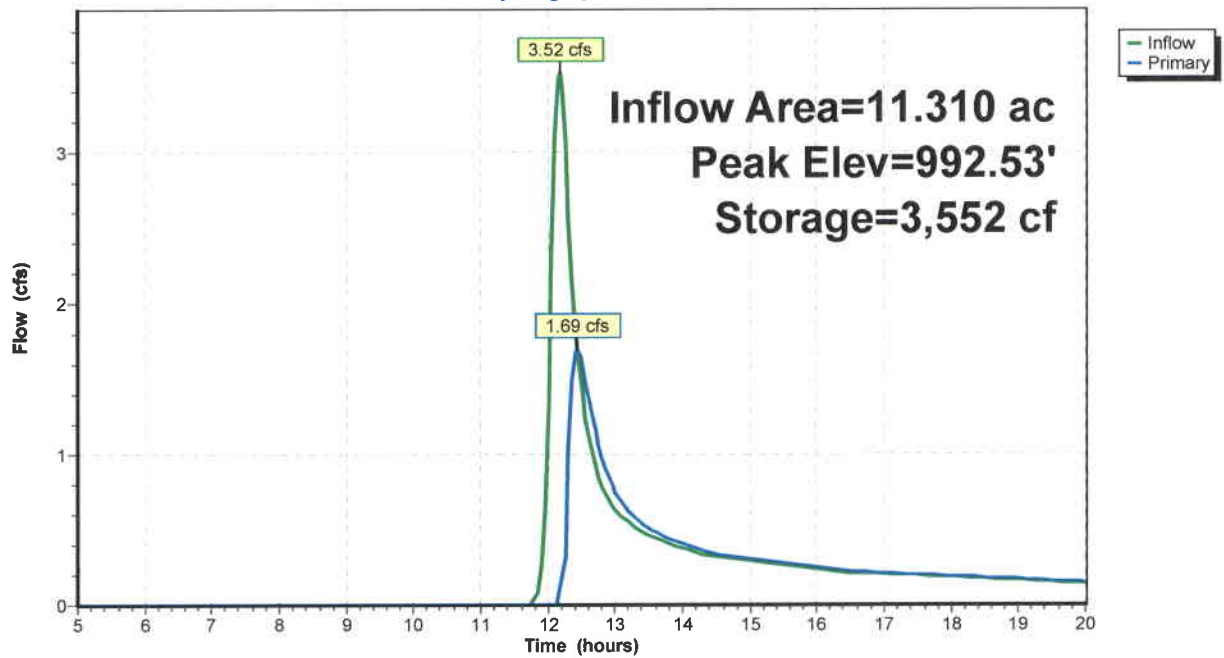
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 12

### Pond 2P: Existing Wetlands

Hydrograph



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 13

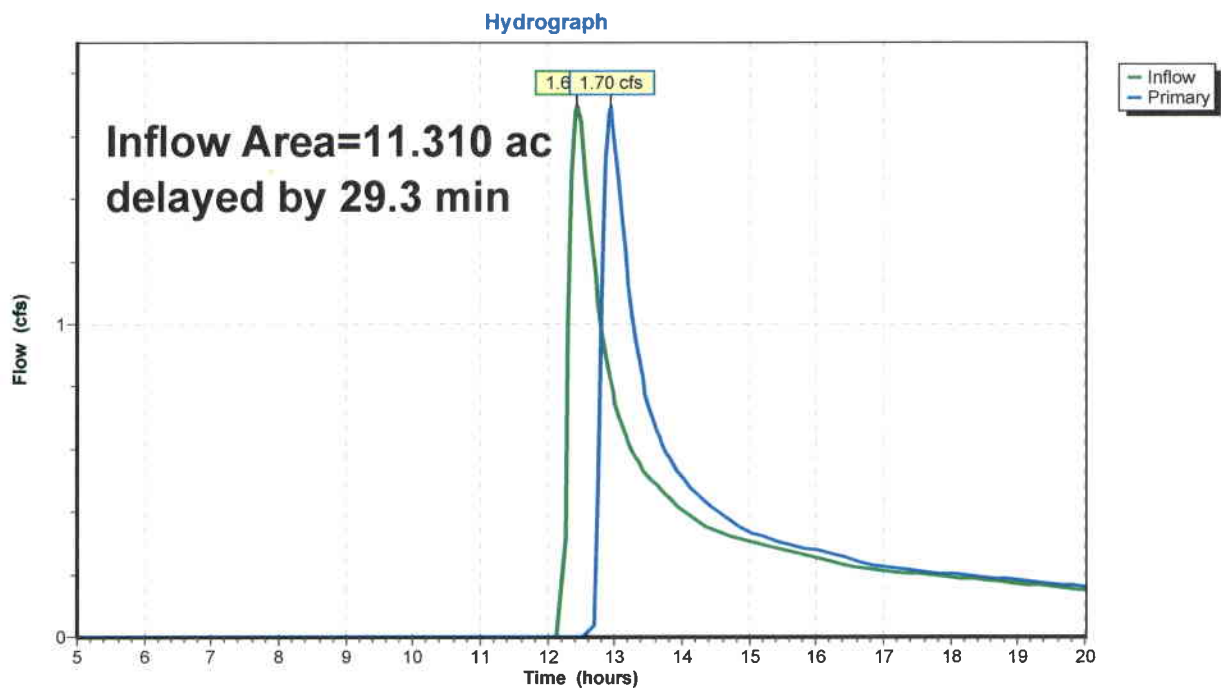
### Summary for Link 3L: Time Lag (see notes)

Flow from the existing wetlands flows through Watershed #1B. To effectively model this condition, a time lag was inserted between WS #1A and the POA. 29.3 minutes was derived by calculating  $T_c$  assuming shallow concentrated flow for 815 feet @ 0.44%. The cover type used was Short Pasture Grass, which has a Velocity factor of 7.0 ft/s

Inflow Area =	11.310 ac,	9.90% Impervious,	Inflow Depth > 0.25"	for 1-yr event
Inflow =	1.69 cfs @	12.43 hrs,	Volume=	0.233 af
Primary =	1.70 cfs @	12.92 hrs,	Volume=	0.227 af, Atten= 0%, Lag= 29.5 min

Primary outflow = Inflow delayed by 29.3 min, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: Time Lag (see notes)



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 14

**Summary for Subcatchment 1S: WS #1A**

Runoff = 14.41 cfs @ 12.14 hrs, Volume= 1.022 af, Depth&gt; 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
1.120	98	Paved parking, HSG D
0.580	30	Woods, Good, HSG A
2.000	77	Woods, Good, HSG D
0.490	78	Meadow, non-grazed, HSG D
1.100	39	>75% Grass cover, Good, HSG A
6.020	80	>75% Grass cover, Good, HSG D
11.310	75	Weighted Average
10.190		90.10% Pervious Area
1.120		9.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			

**Existing**

Prepared by Microsoft

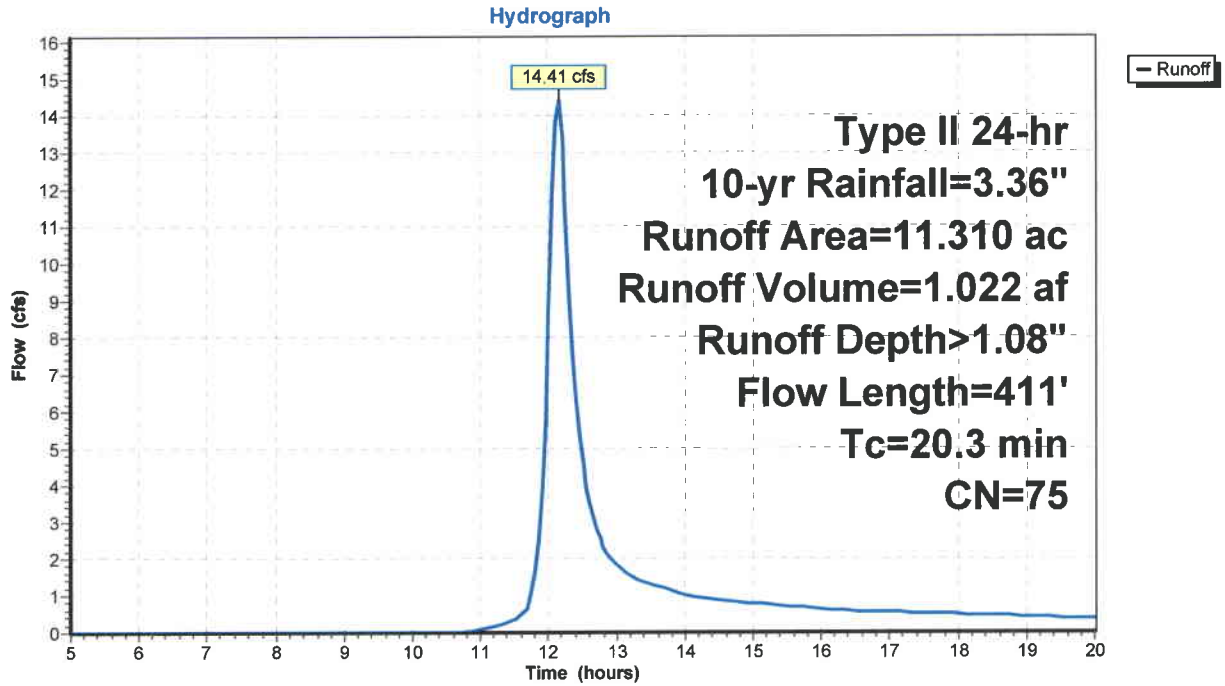
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 15

**Subcatchment 1S: WS #1A**





**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 16

**Summary for Subcatchment 4S: WS #1B**

Runoff = 8.86 cfs @ 12.22 hrs, Volume= 0.799 af, Depth&gt; 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.100	98	Paved parking, HSG D
1.210	30	Woods, Good, HSG A
0.790	77	Woods, Good, HSG D
8.460	78	Meadow, non-grazed, HSG D
1.710	30	Meadow, non-grazed, HSG A
0.850	58	Meadow, non-grazed, HSG B
1.030	80	>75% Grass cover, Good, HSG D
14.150	67	Weighted Average
14.050		99.29% Pervious Area
0.100		0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.9	77	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.2	539	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.0	452	0.0060	1.25		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
25.5	1,386	Total			

**Existing**

Prepared by Microsoft

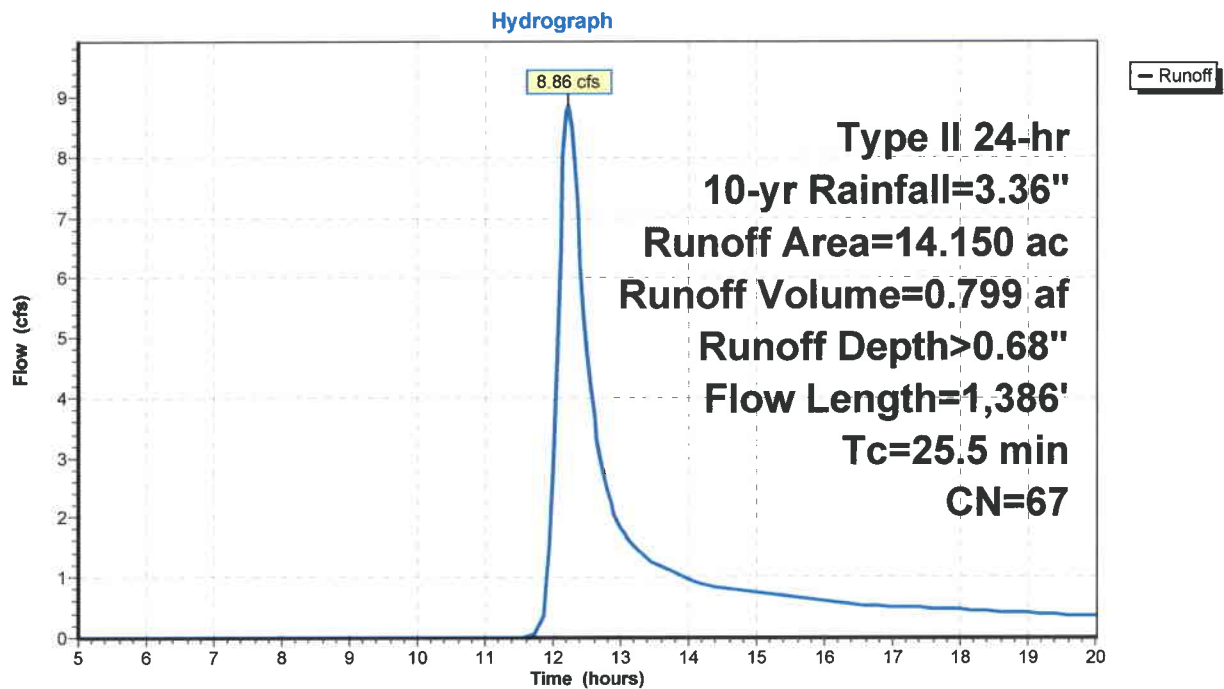
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 17

**Subcatchment 4S: WS #1B**



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 18

**Summary for Subcatchment 6S: WS #2A**

[73] Warning: Peak may fall outside time span

Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth&gt; 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
1.220	30	Woods, Good, HSG A
1.100	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.590	39	Weighted Average
2.440		94.21% Pervious Area
0.150		5.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	43	0.0120	0.07		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 2.31"
11.8	57	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
2.0	151	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	32	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.2	531	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

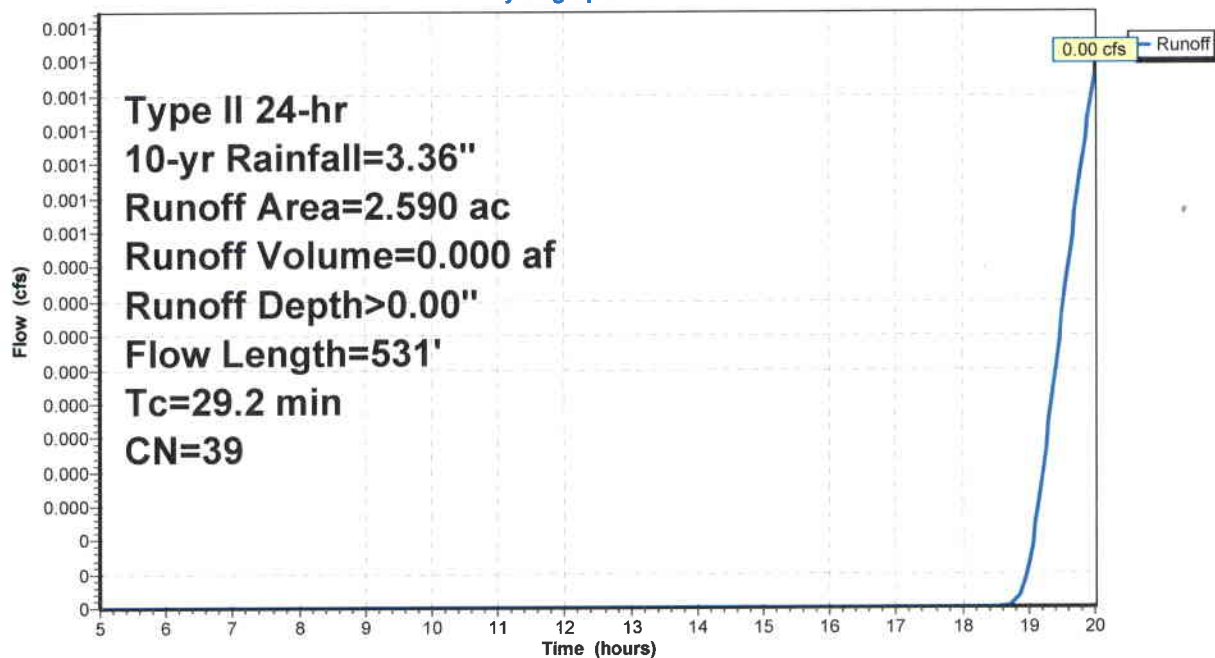
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 19

**Subcatchment 6S: WS #2A**

Hydrograph



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 20

**Summary for Subcatchment 7S: WS #2B**

Runoff = 2.61 cfs @ 12.11 hrs, Volume= 0.193 af, Depth&gt; 0.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.830	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.580	30	Meadow, non-grazed, HSG A
0.140	58	Meadow, non-grazed, HSG B
0.300	39	>75% Grass cover, Good, HSG A
2.920	61	>75% Grass cover, Good, HSG B
4.870	62	Weighted Average
4.040		82.96% Pervious Area
0.830		17.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			

**Existing**

Prepared by Microsoft

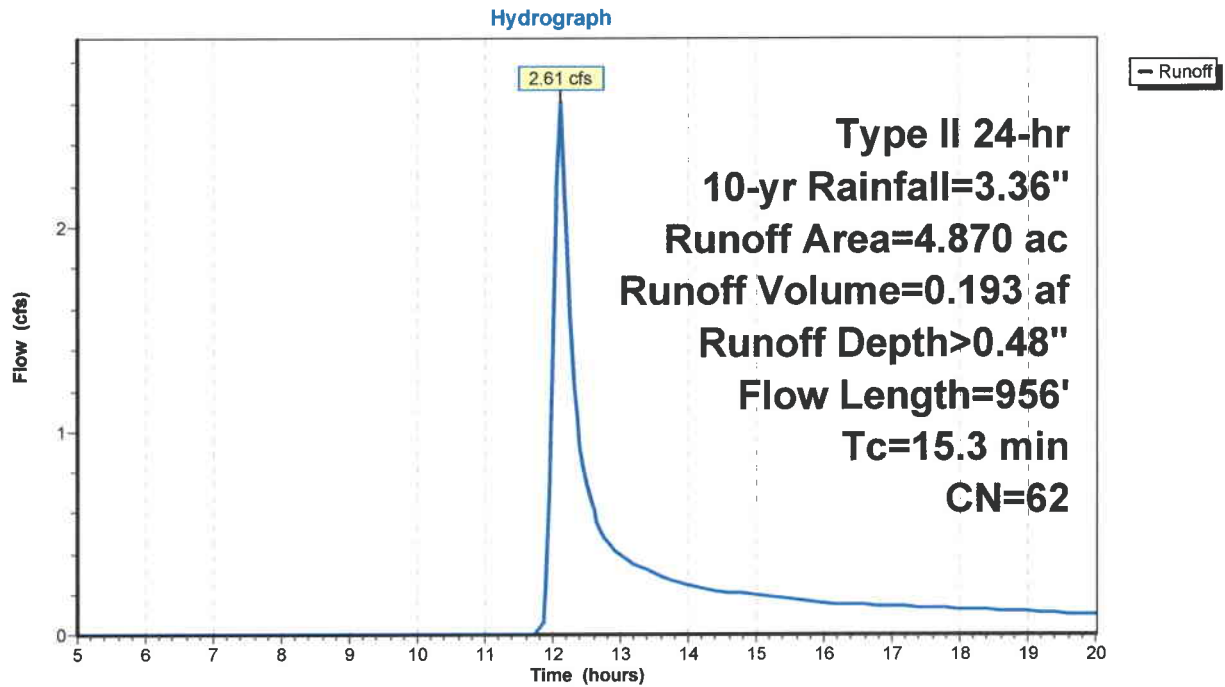
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 21

**Subcatchment 7S: WS #2B**



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 22

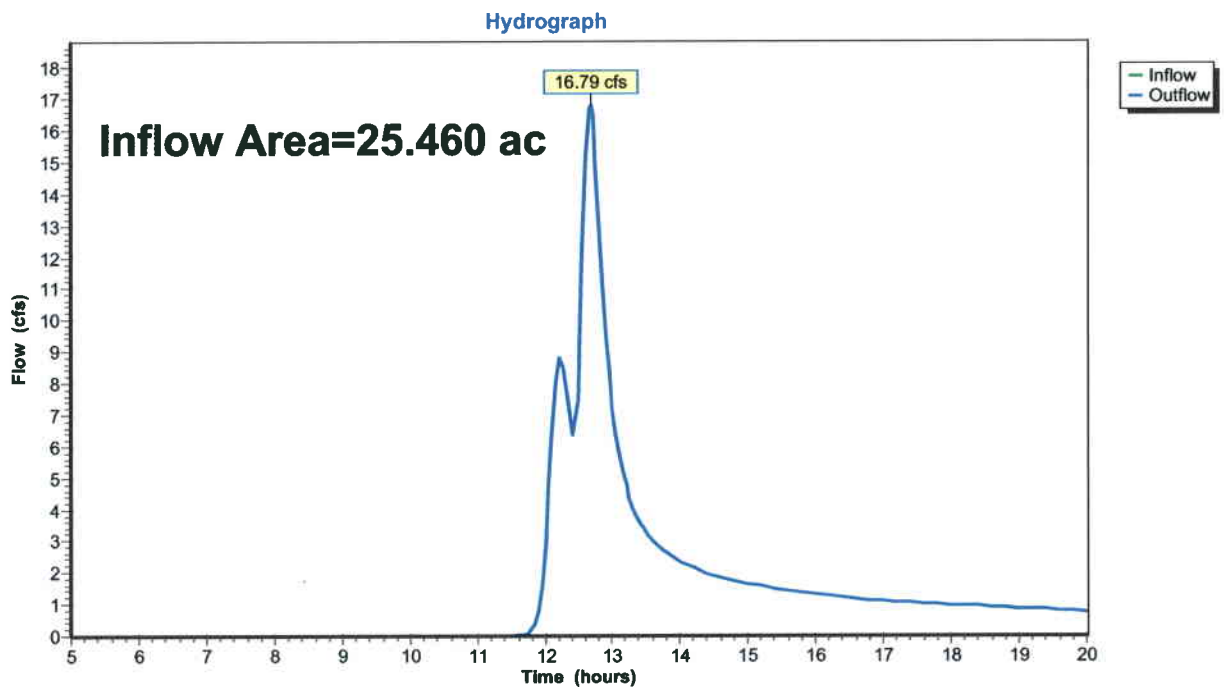
### Summary for Reach 5R: WS #1 POA

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 25.460 ac, 4.79% Impervious, Inflow Depth > 0.82" for 10-yr event  
Inflow = 16.79 cfs @ 12.67 hrs, Volume= 1.738 af  
Outflow = 16.79 cfs @ 12.67 hrs, Volume= 1.738 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: WS #1 POA



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 23

**Summary for Pond 2P: Existing Wetlands**

Inflow Area = 11.310 ac, 9.90% Impervious, Inflow Depth > 1.08" for 10-yr event  
 Inflow = 14.41 cfs @ 12.14 hrs, Volume= 1.022 af  
**Outflow = 13.76 cfs @ 12.19 hrs, Volume= 0.955 af, Atten= 5%, Lag= 2.9 min**  
 Primary = 13.76 cfs @ 12.19 hrs, Volume= 0.955 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.68' @ 12.19 hrs Surf.Area= 19,790 sf Storage= 5,952 cf

Plug-Flow detention time= 34.7 min calculated for 0.951 af (93% of inflow)  
 Center-of-Mass det. time= 12.2 min ( 827.2 - 815.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	14,723 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	34,207	11,557	14,723

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -82.00 -58.00 0.00 51.00 Height (feet) 0.58 0.25 0.00 0.58

**Primary OutFlow** Max=13.65 cfs @ 12.19 hrs HW=992.67' TW=0.00' (Dynamic Tailwater)  
 1=Asymmetrical Weir (Weir Controls 13.65 cfs @ 0.67 fps)



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

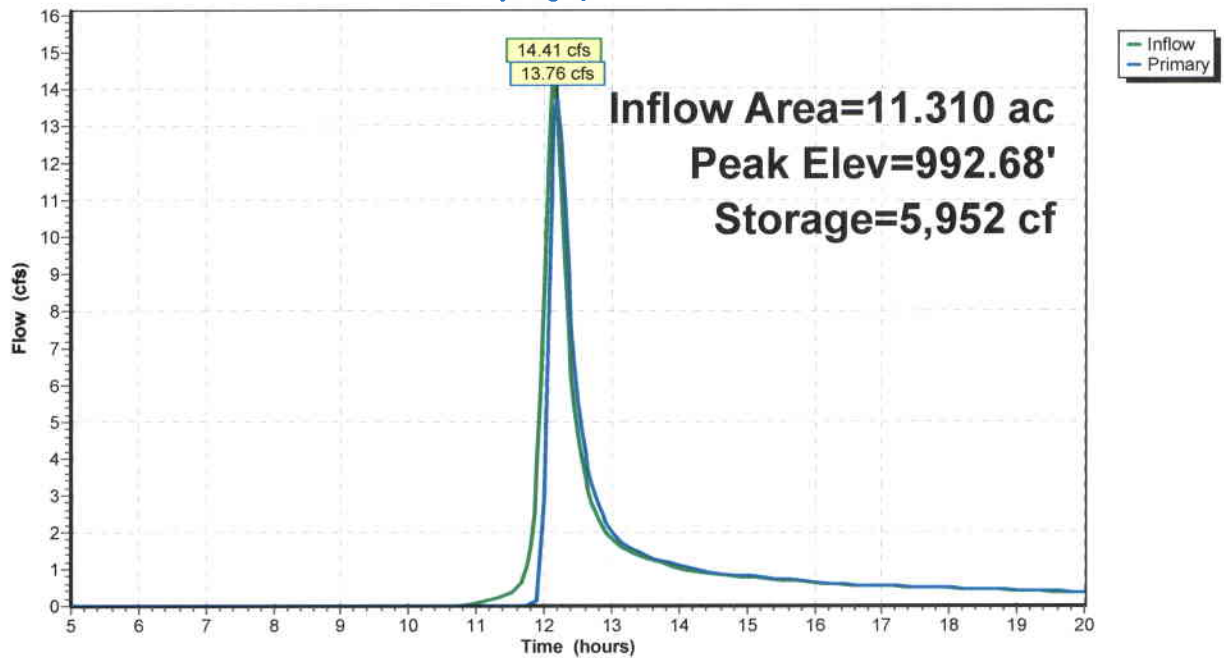
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 24

### Pond 2P: Existing Wetlands

Hydrograph



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 25

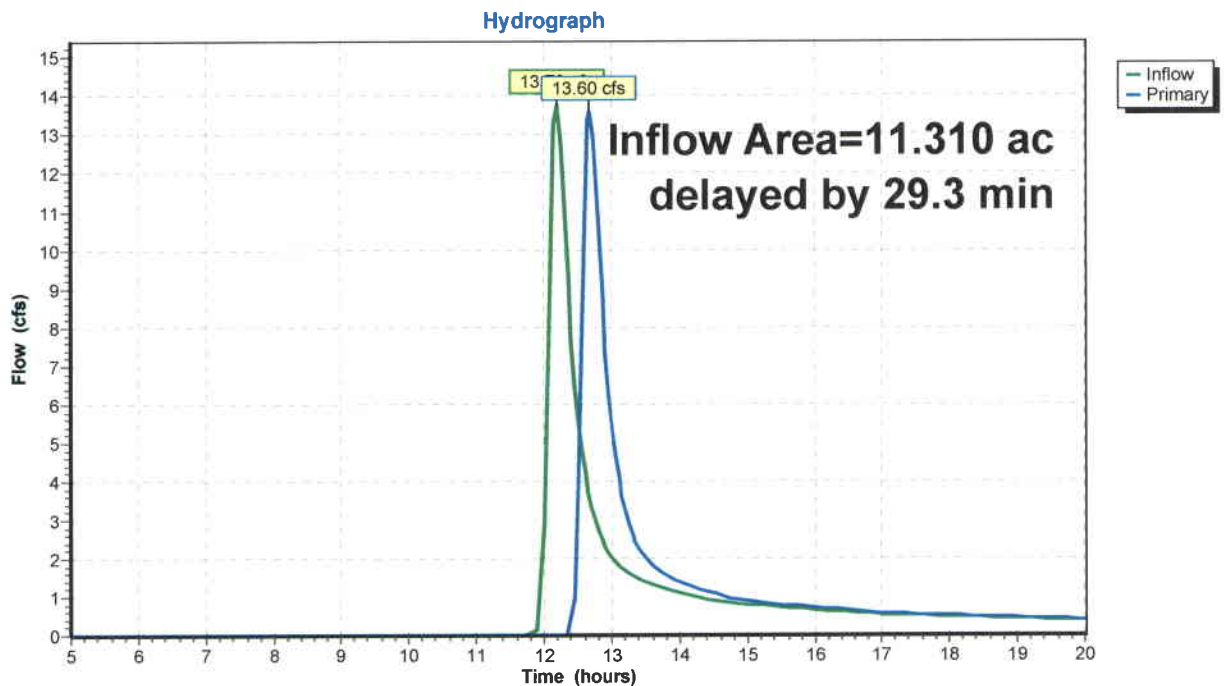
### Summary for Link 3L: Time Lag (see notes)

Flow from the existing wetlands flows through Watershed #1B. To effectively model this condition, a time lag was inserted between WS #1A and the POA. 29.3 minutes was derived by calculating  $T_c$  assuming shallow concentrated flow for 815 feet @ 0.44%. The cover type used was Short Pasture Grass, which has a Velocity factor of 7.0 ft/s

Inflow Area = 11.310 ac, 9.90% Impervious, Inflow Depth > 1.01" for 10-yr event  
Inflow = 13.76 cfs @ 12.19 hrs, Volume= 0.955 af  
Primary = 13.60 cfs @ 12.68 hrs, Volume= 0.939 af, Atten= 1%, Lag= 29.3 min

Primary outflow = Inflow delayed by 29.3 min, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: Time Lag (see notes)



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 26

**Summary for Subcatchment 1S: WS #1A**

Runoff = 37.85 cfs @ 12.13 hrs, Volume= 2.643 af, Depth&gt; 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
1.120	98	Paved parking, HSG D
0.580	30	Woods, Good, HSG A
2.000	77	Woods, Good, HSG D
0.490	78	Meadow, non-grazed, HSG D
1.100	39	>75% Grass cover, Good, HSG A
6.020	80	>75% Grass cover, Good, HSG D
11.310	75	Weighted Average
10.190		90.10% Pervious Area
1.120		9.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

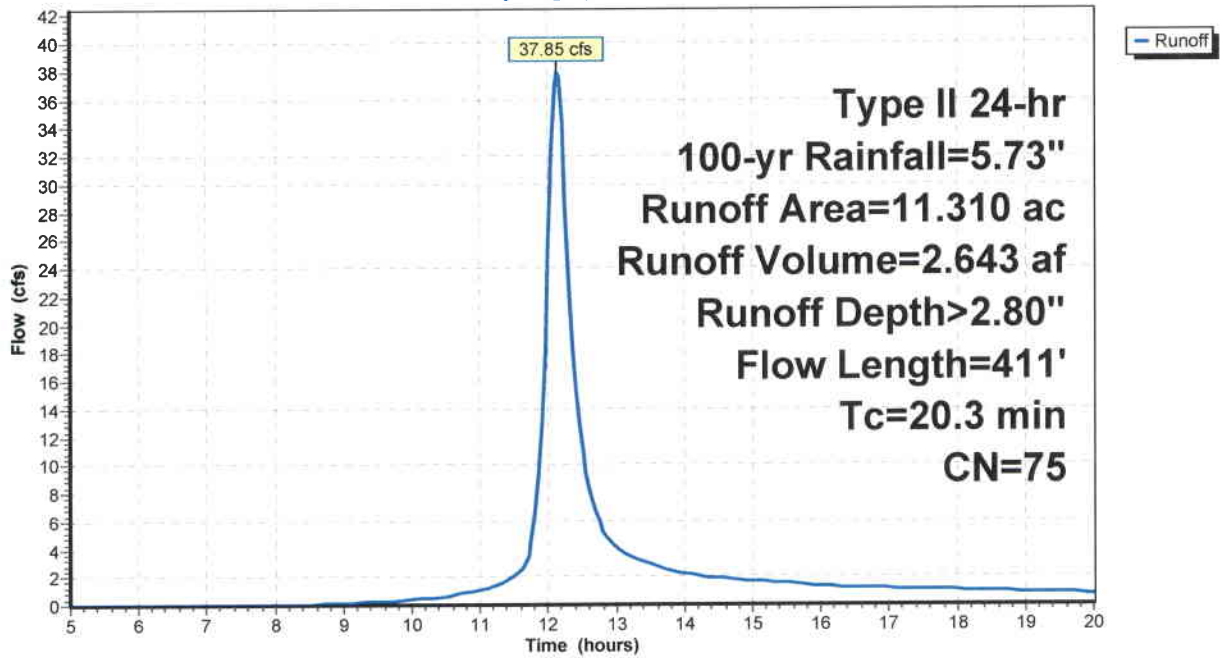
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 27

**Subcatchment 1S: WS #1A**

Hydrograph



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 28

**Summary for Subcatchment 4S: WS #1B**

Runoff = 30.82 cfs @ 12.20 hrs, Volume= 2.483 af, Depth&gt; 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.100	98	Paved parking, HSG D
1.210	30	Woods, Good, HSG A
0.790	77	Woods, Good, HSG D
8.460	78	Meadow, non-grazed, HSG D
1.710	30	Meadow, non-grazed, HSG A
0.850	58	Meadow, non-grazed, HSG B
1.030	80	>75% Grass cover, Good, HSG D
14.150	67	Weighted Average
14.050		99.29% Pervious Area
0.100		0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.9	77	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.2	539	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.0	452	0.0060	1.25		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
25.5	1,386	Total			

Existing

Prepared by Microsoft

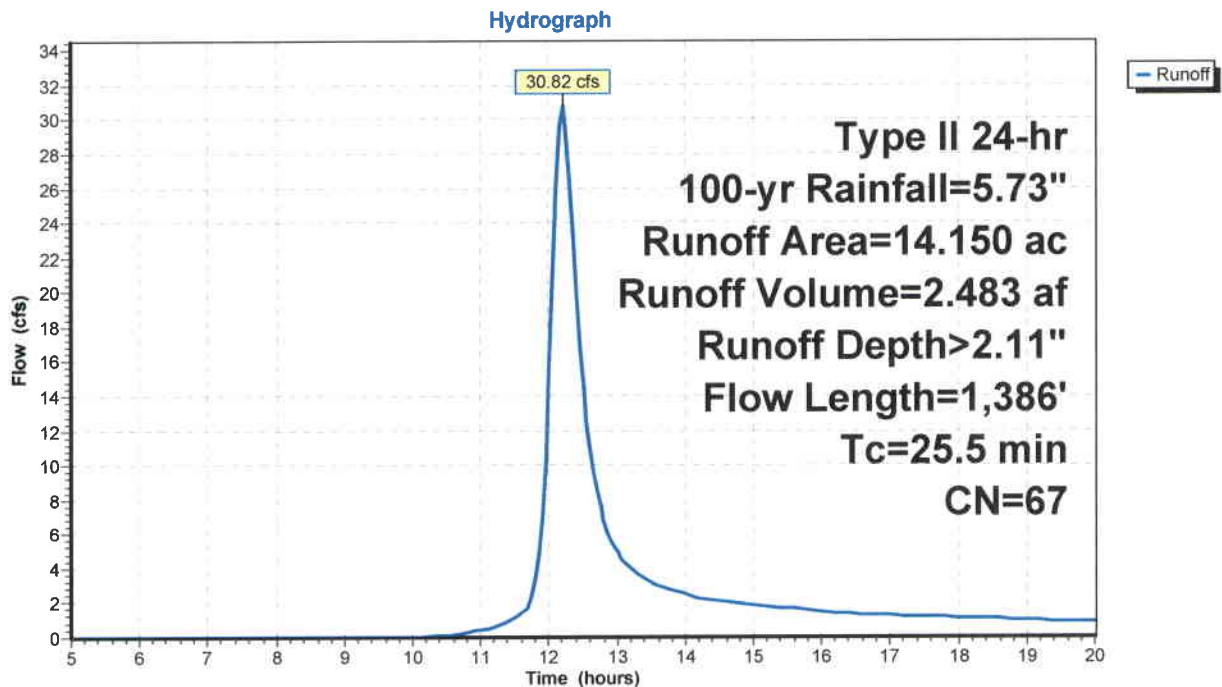
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 29

### Subcatchment 4S: WS #1B



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 30

**Summary for Subcatchment 6S: WS #2A**

Runoff = 0.26 cfs @ 12.44 hrs, Volume= 0.063 af, Depth&gt; 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
1.220	30	Woods, Good, HSG A
1.100	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.590	39	Weighted Average
2.440		94.21% Pervious Area
0.150		5.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	43	0.0120	0.07		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 2.31"
11.8	57	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
2.0	151	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	32	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.2	531	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

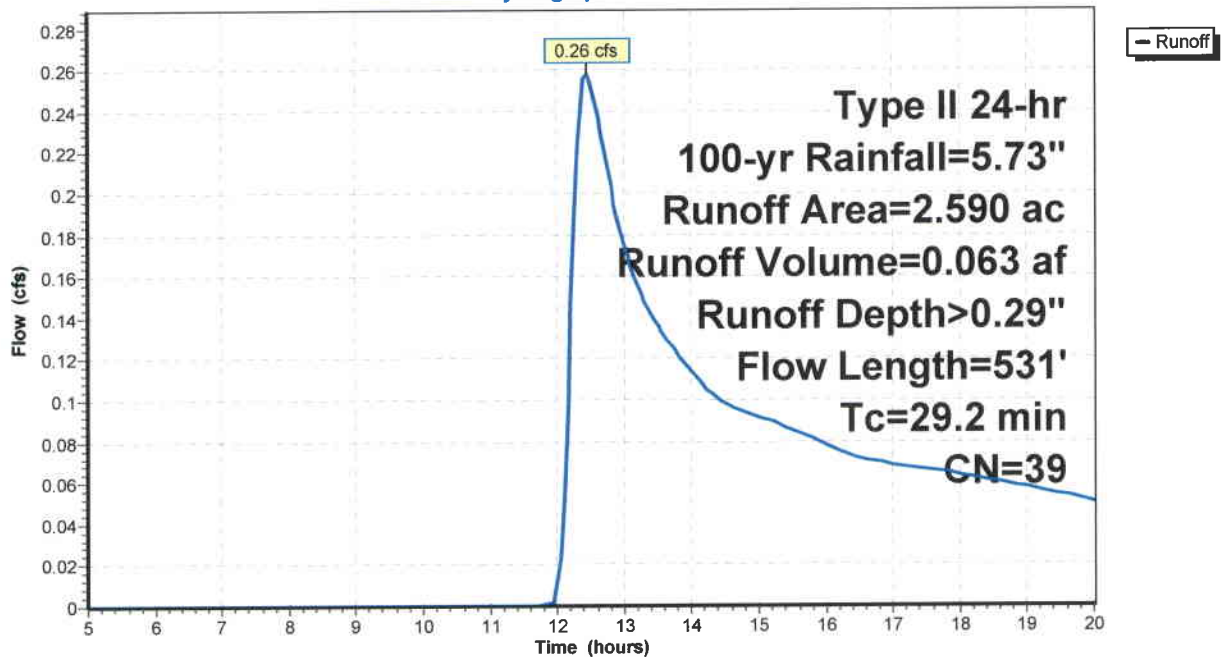
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 31

**Subcatchment 6S: WS #2A**

Hydrograph





**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 32

**Summary for Subcatchment 7S: WS #2B**

Runoff = 11.39 cfs @ 12.09 hrs, Volume= 0.697 af, Depth&gt; 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.830	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.580	30	Meadow, non-grazed, HSG A
0.140	58	Meadow, non-grazed, HSG B
0.300	39	>75% Grass cover, Good, HSG A
2.920	61	>75% Grass cover, Good, HSG B
4.870	62	Weighted Average
4.040		82.96% Pervious Area
0.830		17.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			

**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

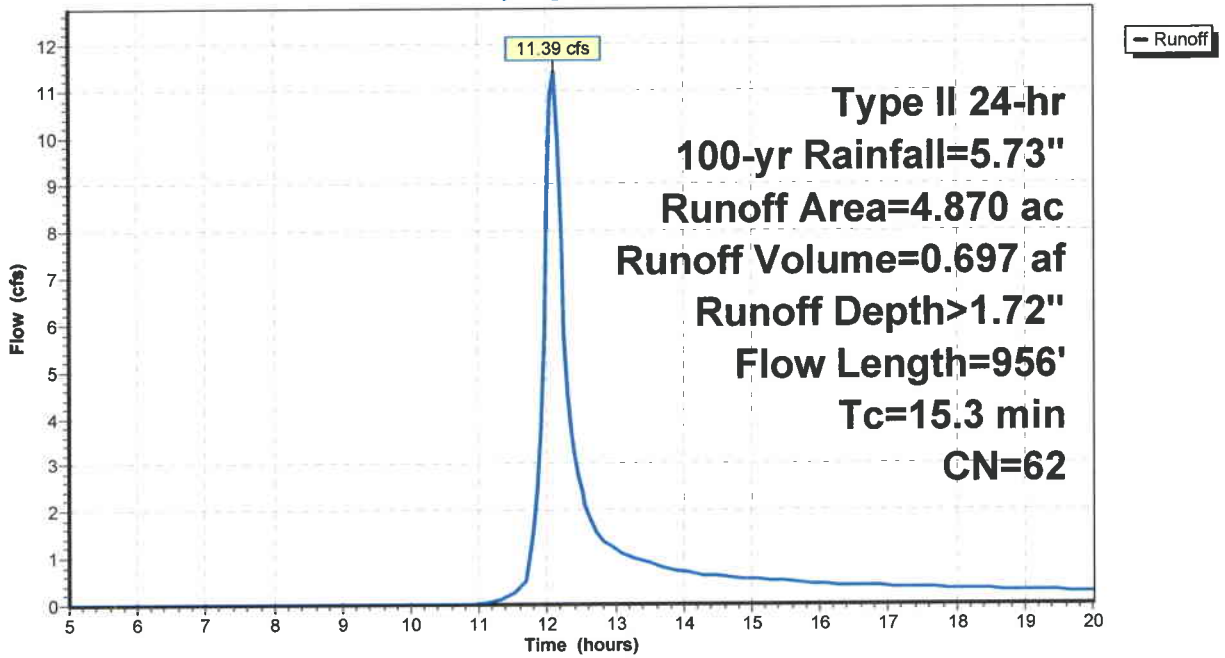
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 33

**Subcatchment 7S: WS #2B**

Hydrograph



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 34

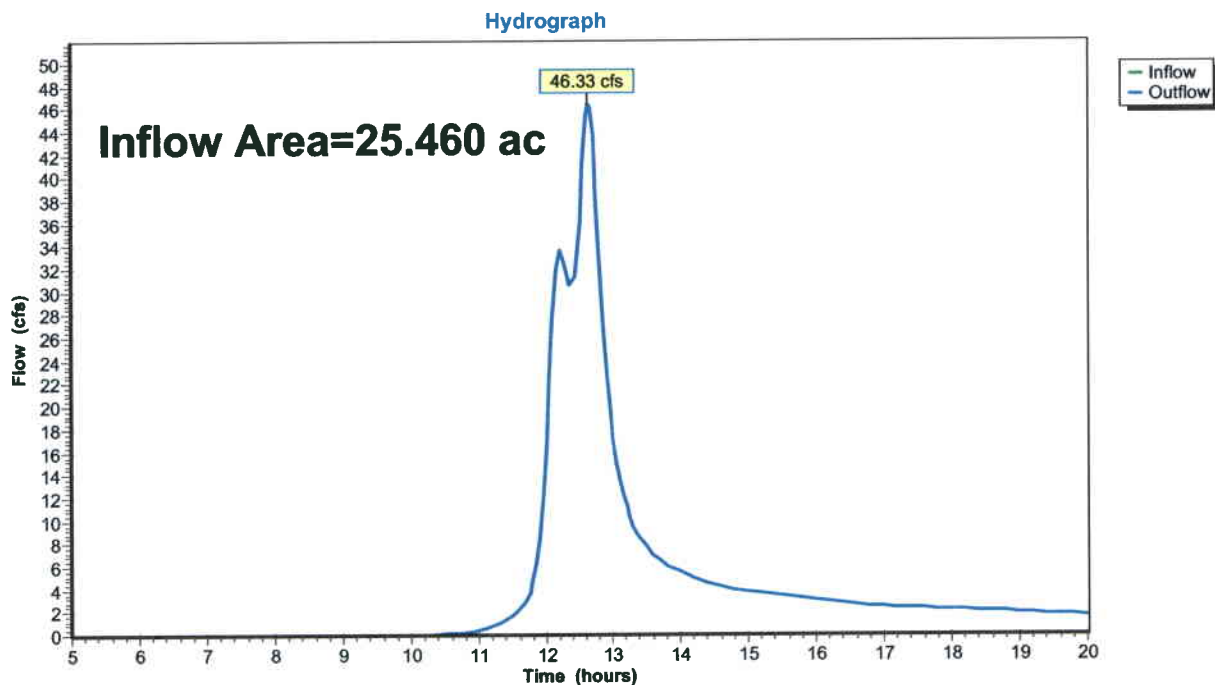
### Summary for Reach 5R: WS #1 POA

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 25.460 ac, 4.79% Impervious, Inflow Depth > 2.37" for 100-yr event  
Inflow = 46.33 cfs @ 12.64 hrs, Volume= 5.022 af  
Outflow = 46.33 cfs @ 12.64 hrs, Volume= 5.022 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: WS #1 POA



**Existing**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 35

**Summary for Pond 2P: Existing Wetlands**

Inflow Area = 11.310 ac, 9.90% Impervious, Inflow Depth > 2.80" for 100-yr event  
 Inflow = 37.85 cfs @ 12.13 hrs, Volume= 2.643 af  
 Outflow = 37.06 cfs @ 12.17 hrs, Volume= 2.571 af, Atten= 2%, Lag= 2.0 min  
 Primary = 37.06 cfs @ 12.17 hrs, Volume= 2.571 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.80' @ 12.17 hrs Surf.Area= 25,548 sf Storage= 8,893 cf

Plug-Flow detention time= 18.6 min calculated for 2.562 af (97% of inflow)  
 Center-of-Mass det. time= 8.4 min ( 803.7 - 795.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	14,723 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	34,207	11,557	14,723

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -82.00 -58.00 0.00 51.00 Height (feet) 0.58 0.25 0.00 0.58

**Primary OutFlow** Max=36.63 cfs @ 12.17 hrs HW=992.80' TW=0.00' (Dynamic Tailwater)  
 1=Asymmetrical Weir (Weir Controls 36.63 cfs @ 1.01 fps)

## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

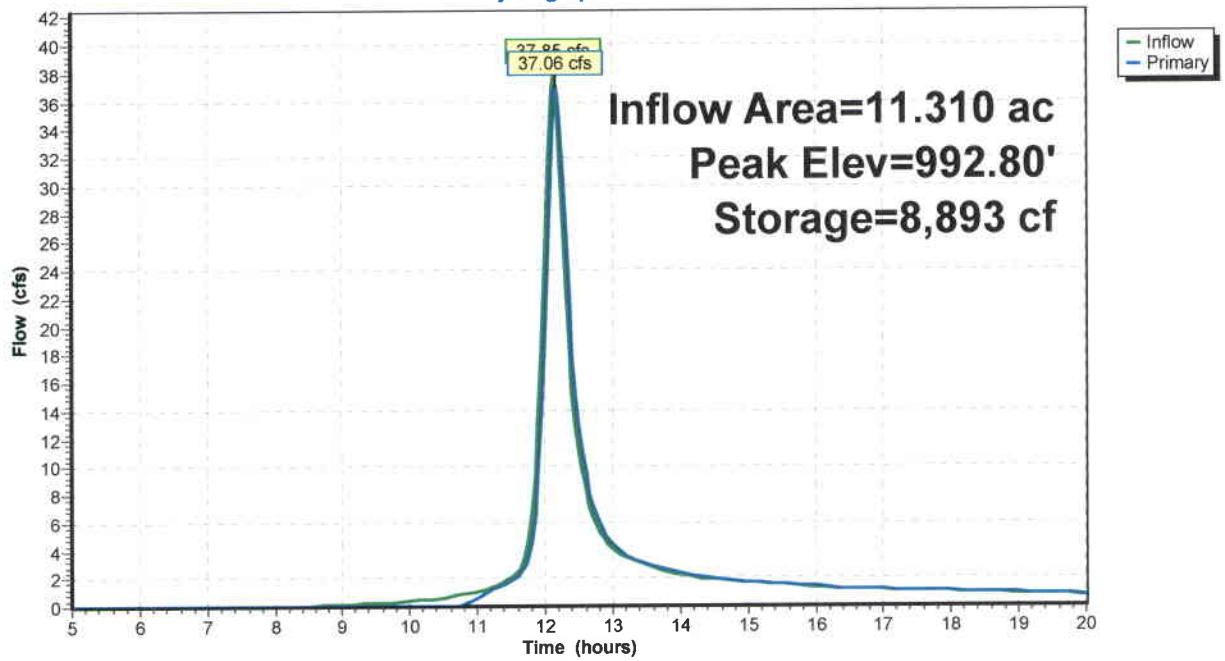
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 36

### Pond 2P: Existing Wetlands

Hydrograph



## Existing

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 37

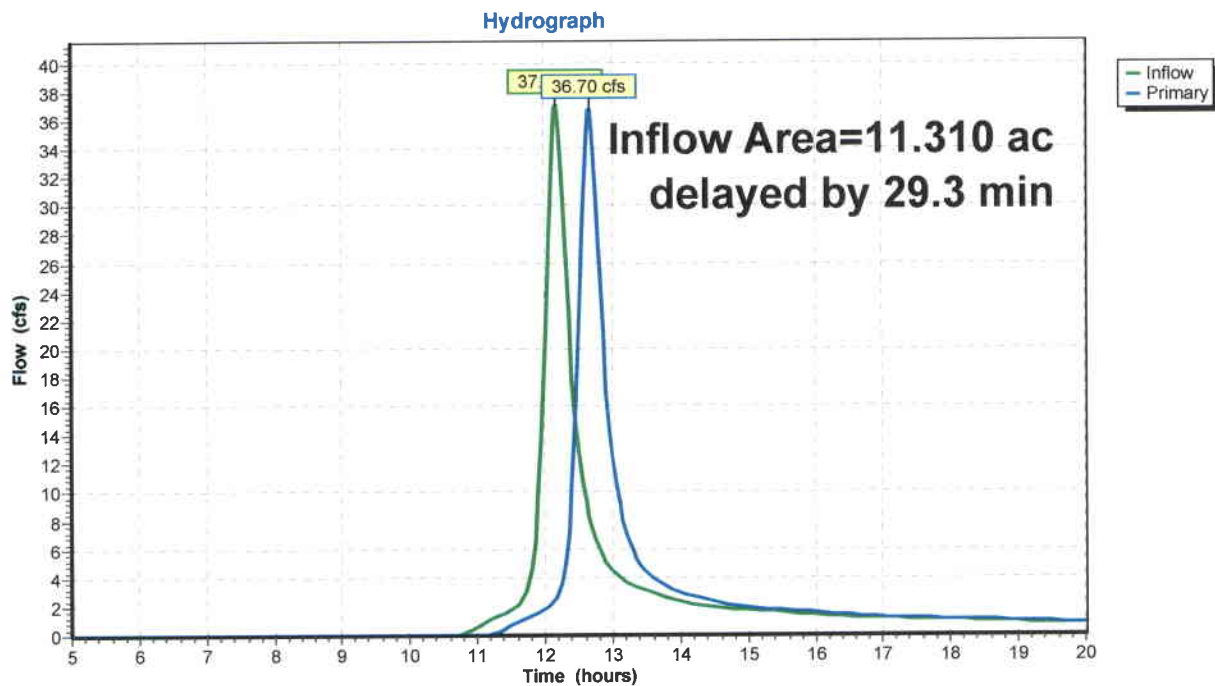
### Summary for Link 3L: Time Lag (see notes)

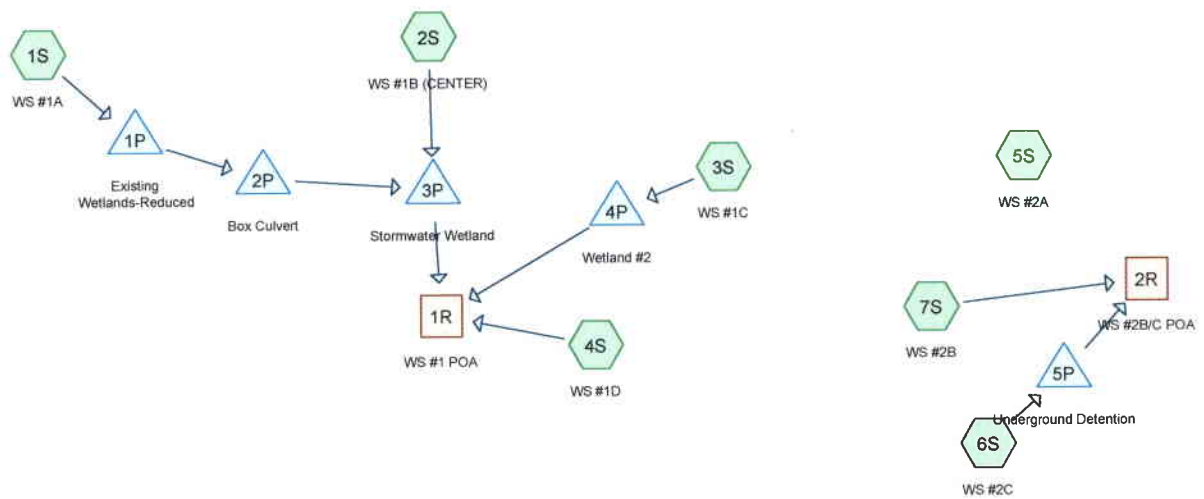
Flow from the existing wetlands flows through Watershed #1B. To effectively model this condition, a time lag was inserted between WS #1A and the POA. 29.3 minutes was derived by calculating  $T_c$  assuming shallow concentrated flow for 815 feet @ 0.44%. The cover type used was Short Pasture Grass, which has a Velocity factor of 7.0 ft/s

Inflow Area = 11.310 ac, 9.90% Impervious, Inflow Depth > 2.73" for 100-yr event  
Inflow = 37.06 cfs @ 12.17 hrs, Volume= 2.571 af  
Primary = 36.70 cfs @ 12.66 hrs, Volume= 2.538 af, Atten= 1%, Lag= 29.4 min

Primary outflow = Inflow delayed by 29.3 min, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: Time Lag (see notes)





**Routing Diagram for Proposed**  
 Prepared by Microsoft, Printed 12/14/2017  
 HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 2

**Summary for Subcatchment 1S: WS #1A**

Runoff = 2.79 cfs @ 12.17 hrs, Volume= 0.235 af, Depth&gt; 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.890	98	Paved parking, HSG D
0.260	30	Woods, Good, HSG A
1.580	77	Woods, Good, HSG D
1.100	39	>75% Grass cover, Good, HSG A
5.140	80	>75% Grass cover, Good, HSG D
8.970	75	Weighted Average
8.080		90.08% Pervious Area
0.890		9.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

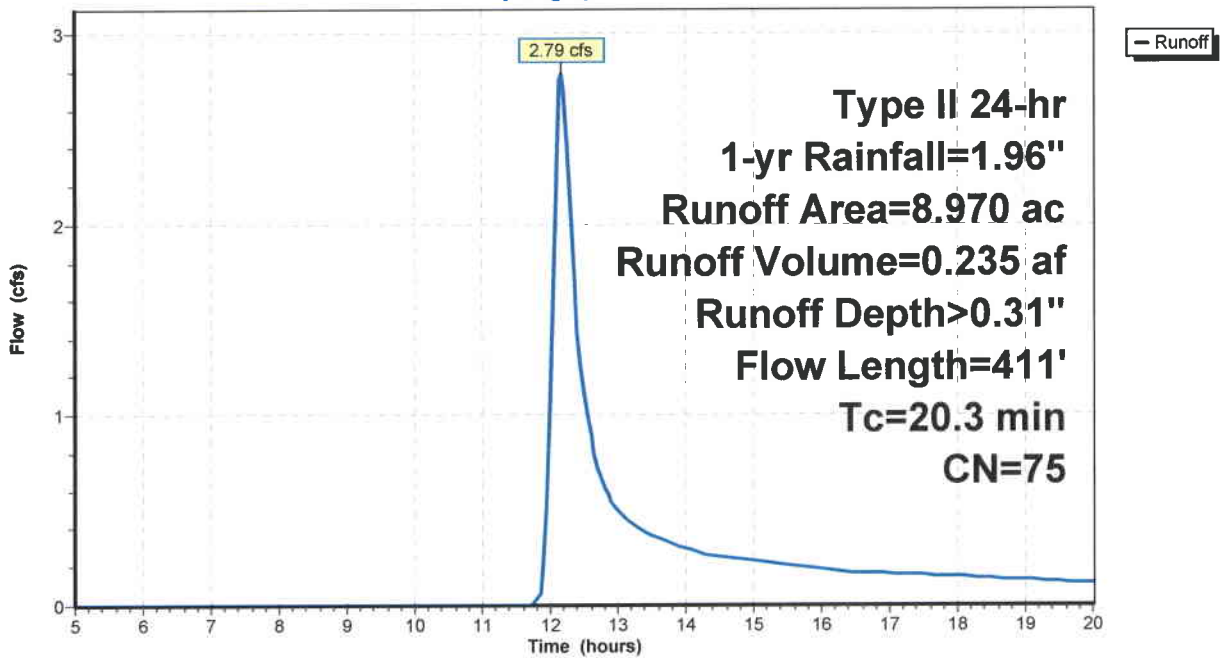
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 3

**Subcatchment 1S: WS #1A**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 4

**Summary for Subcatchment 2S: WS #1B (CENTER)**

Runoff = 8.00 cfs @ 12.10 hrs, Volume= 0.532 af, Depth&gt; 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
4.670	98	Paved parking, HSG D
2.190	39	>75% Grass cover, Good, HSG A
0.210	61	>75% Grass cover, Good, HSG B
7.820	80	>75% Grass cover, Good, HSG D
0.470	30	Woods, Good, HSG A
0.290	77	Woods, Good, HSG D
15.650	78	Weighted Average
10.980		70.16% Pervious Area
4.670		29.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.5	62	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.3	60	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
2.7	250	0.0025	1.56	15.55	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=0.00' D=1.00' Z= 10.0 ' Top.W=20.00' n= 0.030 Short grass
0.1	77	0.0480	9.94	7.81	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.0	767	Total			

**Proposed**

Prepared by Microsoft

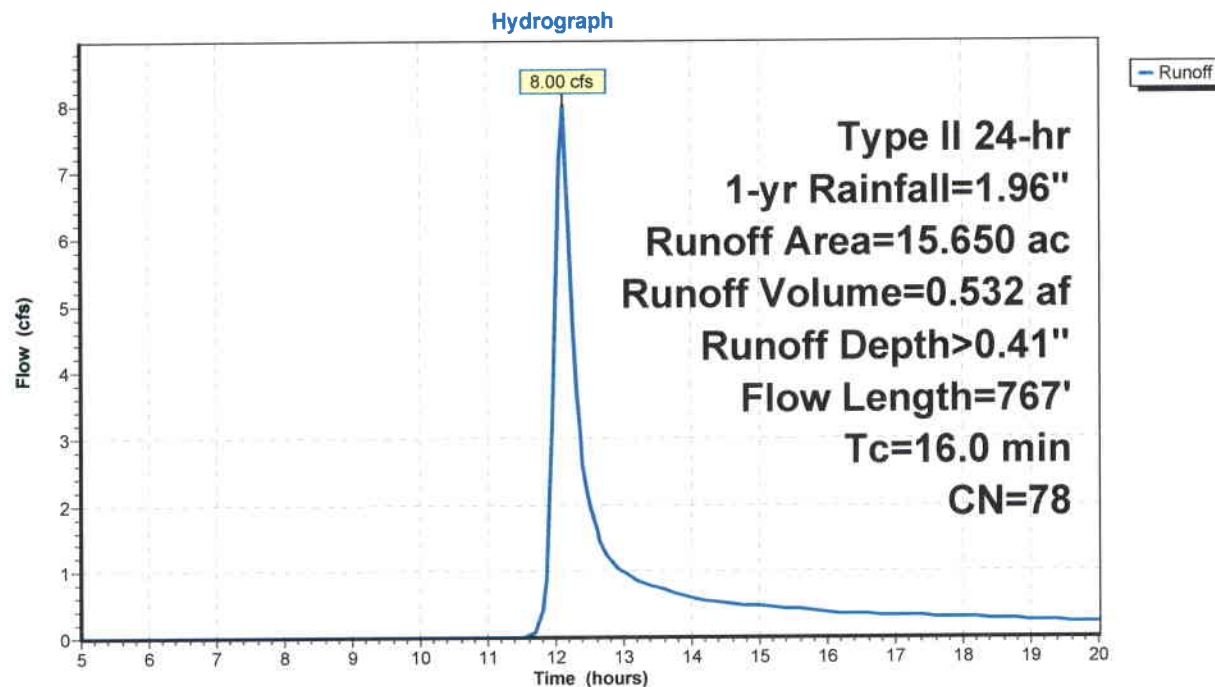
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 5

**Subcatchment 2S: WS #1B (CENTER)**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 6

**Summary for Subcatchment 3S: WS #1C**

Runoff = 0.00 cfs @ 17.70 hrs, Volume= 0.001 af, Depth&gt; 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

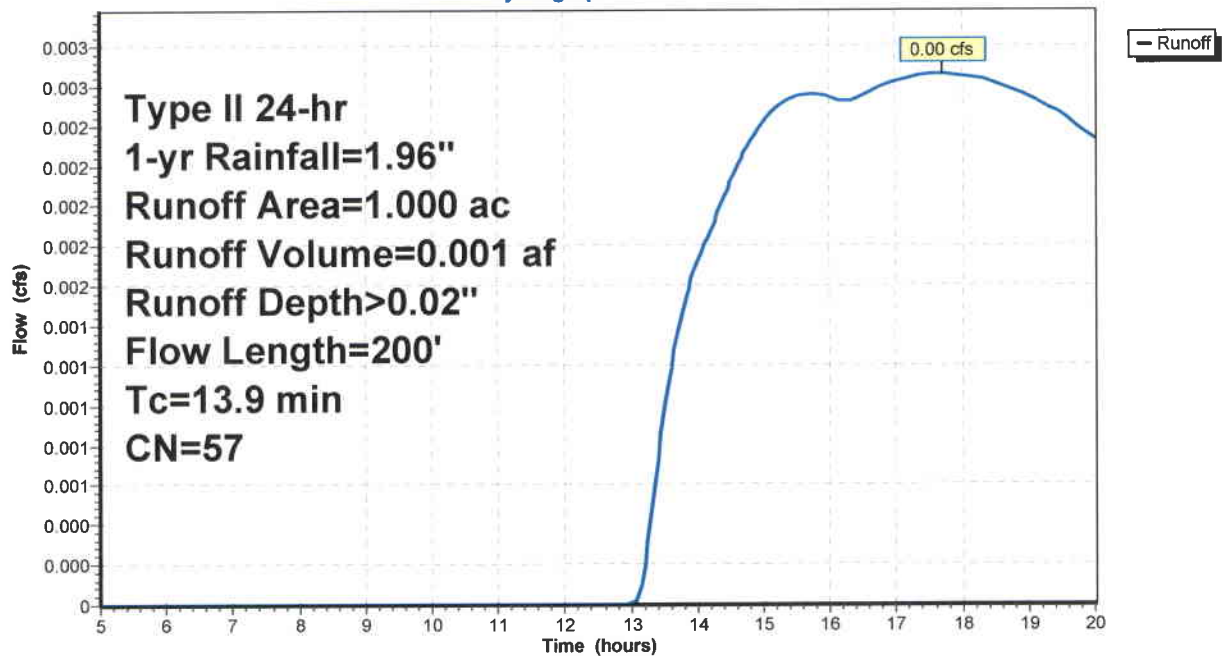
Area (ac)	CN	Description
0.080	98	Paved parking, HSG D
0.320	39	>75% Grass cover, Good, HSG A
0.600	61	>75% Grass cover, Good, HSG B
1.000	57	Weighted Average
0.920		92.00% Pervious Area
0.080		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	100	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.0	100	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
13.9	200	Total			

**Subcatchment 3S: WS #1C**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

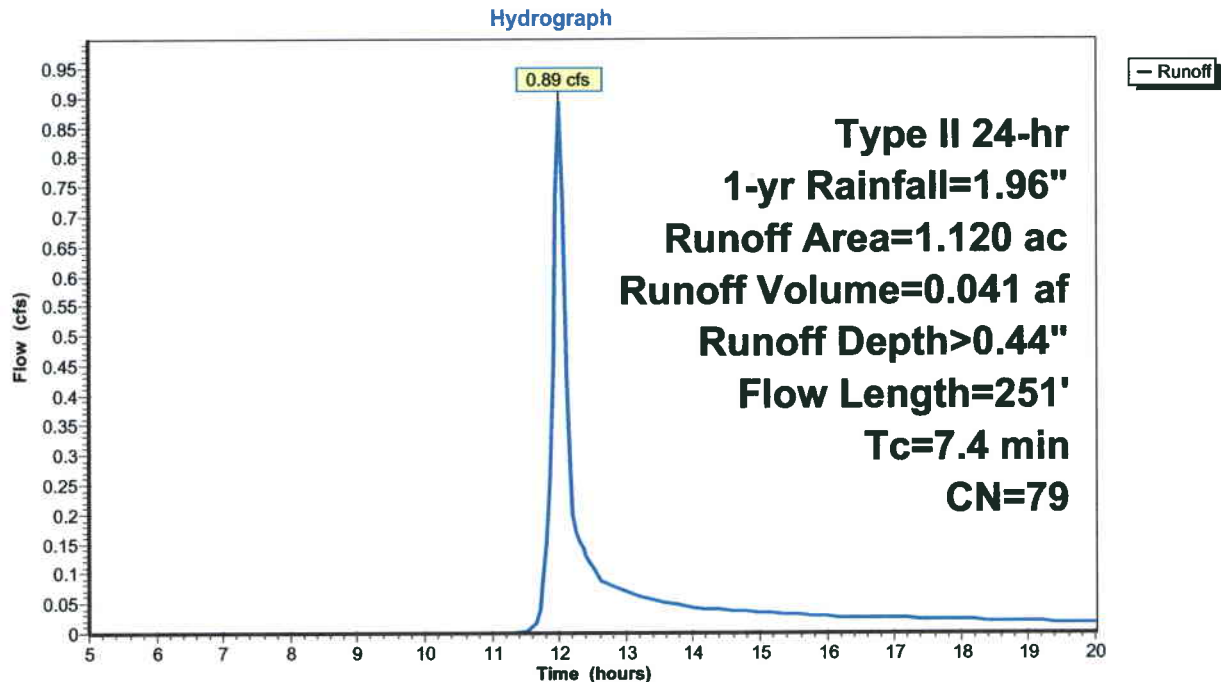
Page 7

**Summary for Subcatchment 4S: WS #1D****Runoff = 0.89 cfs @ 12.00 hrs, Volume= 0.041 af, Depth> 0.44"**Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.680	78	Meadow, non-grazed, HSG D
0.440	80	>75% Grass cover, Good, HSG D
1.120	79	Weighted Average
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0900	0.24		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
2.9	186	0.0044	1.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.4	251	Total			

**Subcatchment 4S: WS #1D**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 8

**Summary for Subcatchment 5S: WS #2A**

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
0.940	30	Woods, Good, HSG A
1.170	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.380	40	Weighted Average
2.230		93.70% Pervious Area
0.150		6.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	40	0.0250	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
12.3	60	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.4	95	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	90	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.8	533	Total			

**Proposed**

Prepared by Microsoft

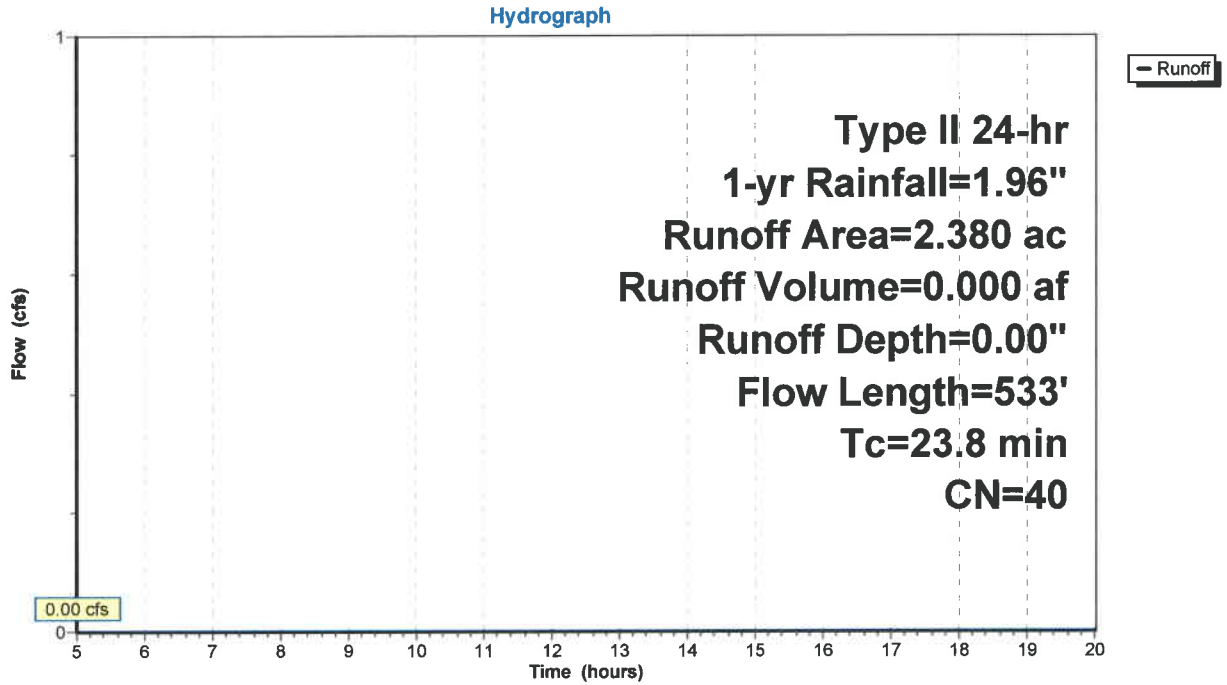
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 9

**Subcatchment 5S: WS #2A**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 10

**Summary for Subcatchment 6S: WS #2C**

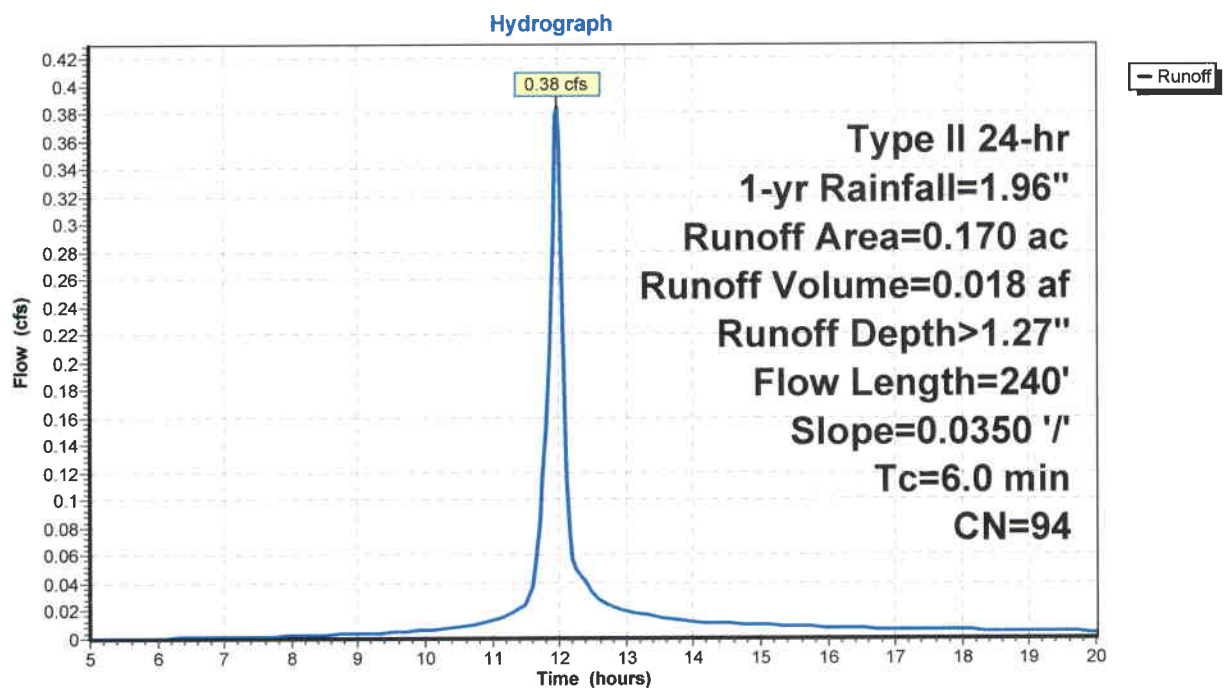
Runoff = 0.38 cfs @ 11.97 hrs, Volume= 0.018 af, Depth&gt; 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG B
0.020	61	>75% Grass cover, Good, HSG B
0.170	94	Weighted Average
0.020		11.76% Pervious Area
0.150		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0350	1.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.31"
0.6	140	0.0350	3.80		Shallow Concentrated Flow, Paved Kv= 20.3 fps
4.3					Direct Entry,
6.0	240	Total			

**Subcatchment 6S: WS #2C**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 11

**Summary for Subcatchment 7S: WS #2B**

Runoff = 0.26 cfs @ 12.16 hrs, Volume= 0.040 af, Depth&gt; 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-yr Rainfall=1.96"

Area (ac)	CN	Description
0.850	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.350	39	>75% Grass cover, Good, HSG A
2.910	61	>75% Grass cover, Good, HSG B
4.210	66	Weighted Average
3.360		79.81% Pervious Area
0.850		20.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

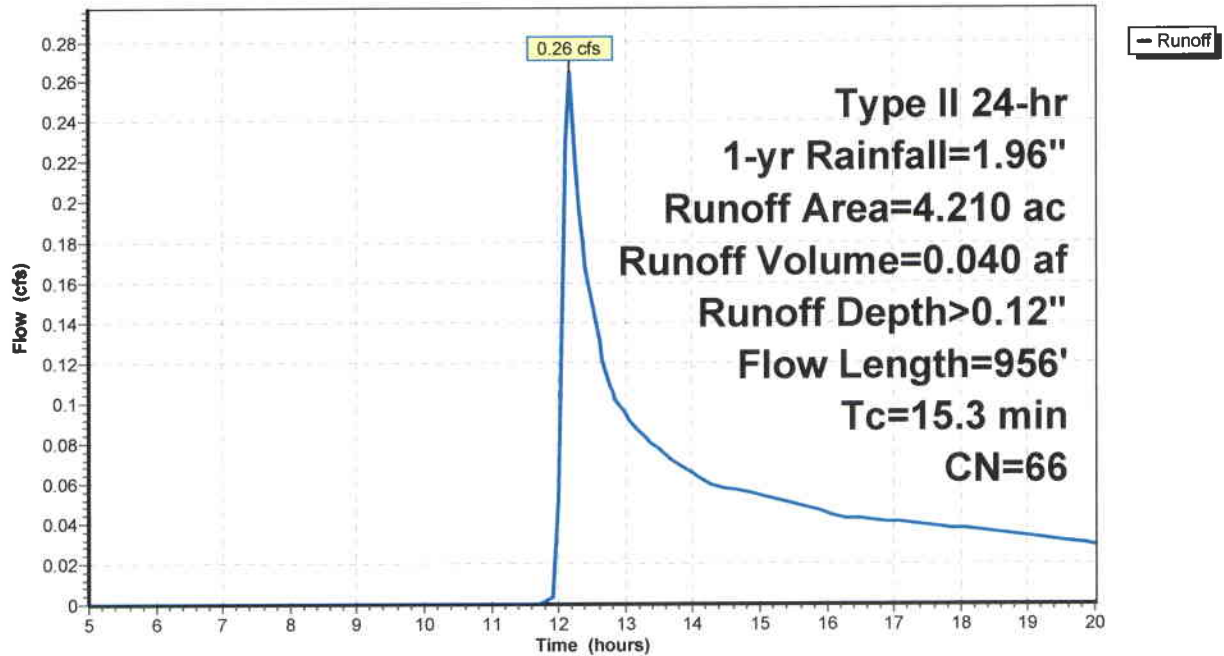
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 12

**Subcatchment 7S: WS #2B**

Hydrograph



## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

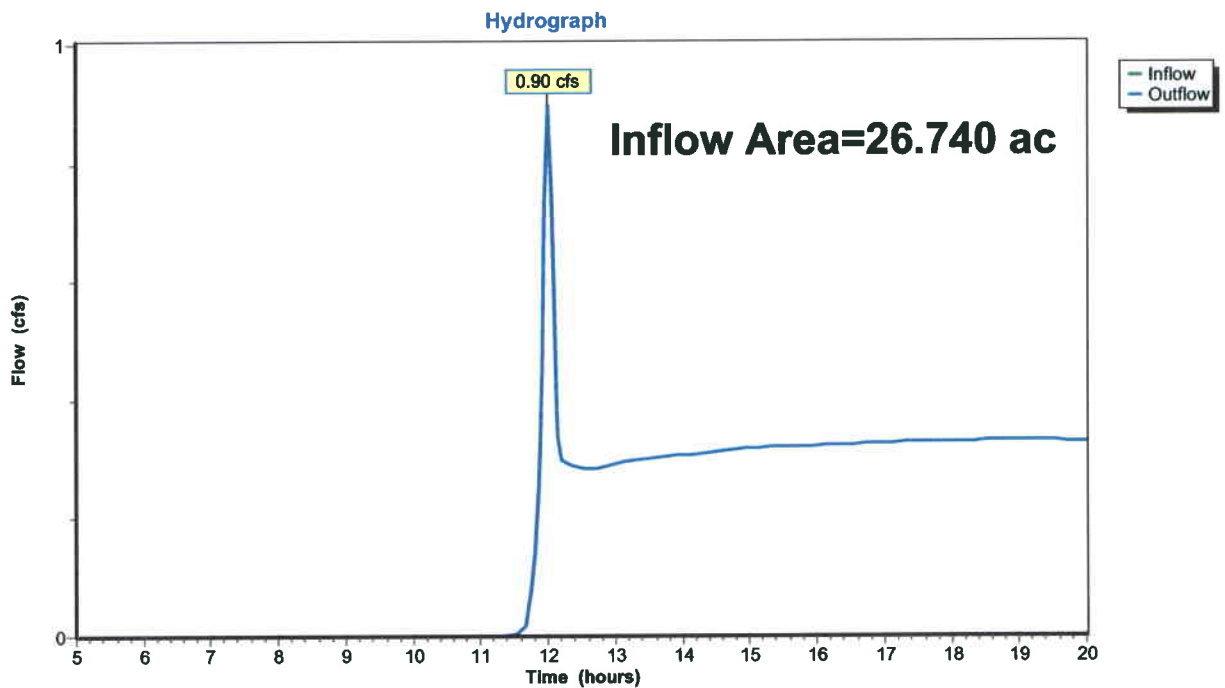
Page 13

### Summary for Reach 1R: WS #1 POA

Inflow Area = 26.740 ac, 21.09% Impervious, Inflow Depth > 0.10" for 1-yr event  
Inflow = 0.90 cfs @ 12.00 hrs, Volume= 0.223 af  
Outflow = 0.90 cfs @ 12.00 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 1R: WS #1 POA



## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 14

### Summary for Reach 2R: WS #2B/C POA

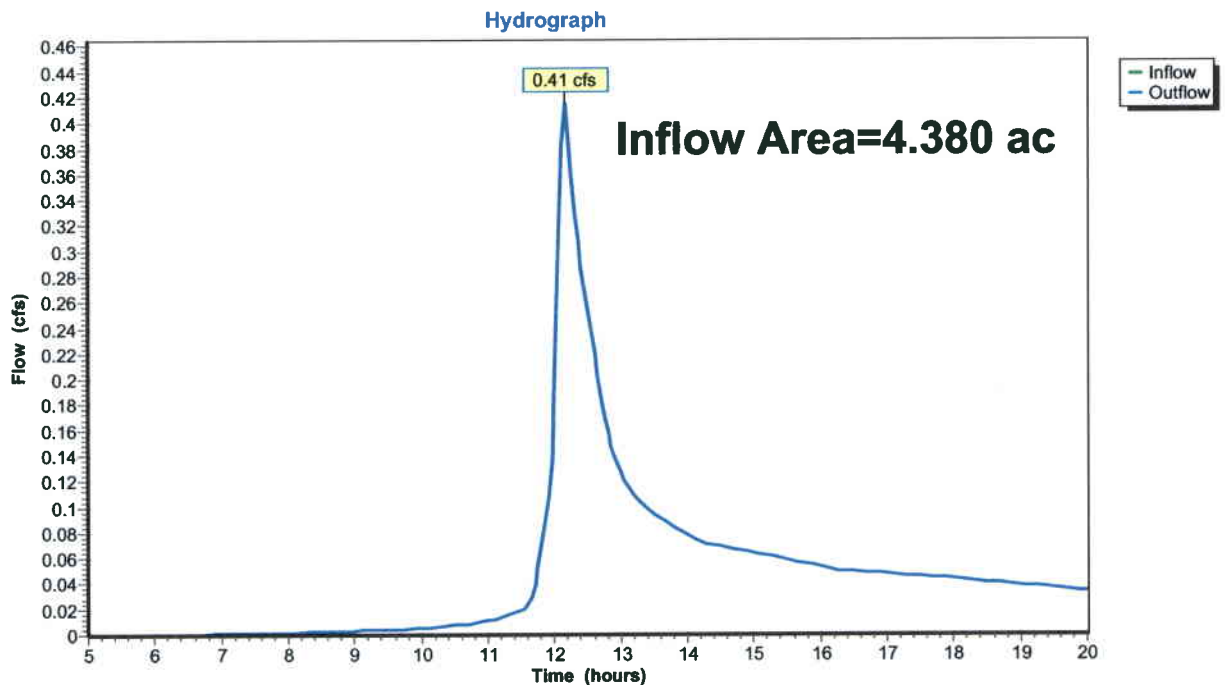
Inflow Area = 4.380 ac, 22.83% Impervious, Inflow Depth > 0.16" for 1-yr event

Inflow = 0.41 cfs @ 12.16 hrs, Volume= 0.058 af

Outflow = 0.41 cfs @ 12.16 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 2R: WS #2B/C POA



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 15

**Summary for Pond 1P: Existing Wetlands-Reduced**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 0.31" for 1-yr event  
 Inflow = 2.79 cfs @ 12.17 hrs, Volume= 0.235 af  
**Outflow = 1.05 cfs @ 12.53 hrs, Volume= 0.173 af, Atten= 62%, Lag= 21.5 min**  
 Primary = 1.05 cfs @ 12.53 hrs, Volume= 0.173 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.51' @ 12.53 hrs Surf.Area= 12,324 sf Storage= 3,267 cf

Plug-Flow detention time= 119.5 min calculated for 0.173 af (74% of inflow)  
 Center-of-Mass det. time= 49.2 min ( 892.7 - 843.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	21,366 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	30,390	10,602	13,769
993.25	30,390	7,598	21,366

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -26.27 -25.00 0.00 20.00 26.27 Height (feet) 0.58 0.13 0.00 0.13 0.58

**Primary OutFlow** Max=1.04 cfs @ 12.53 hrs HW=992.51' TW=992.09' (Dynamic Tailwater)  
 ↳ **1=Asymmetrical Weir** (Weir Controls 1.04 cfs @ 0.39 fps)

**Proposed**

Prepared by Microsoft

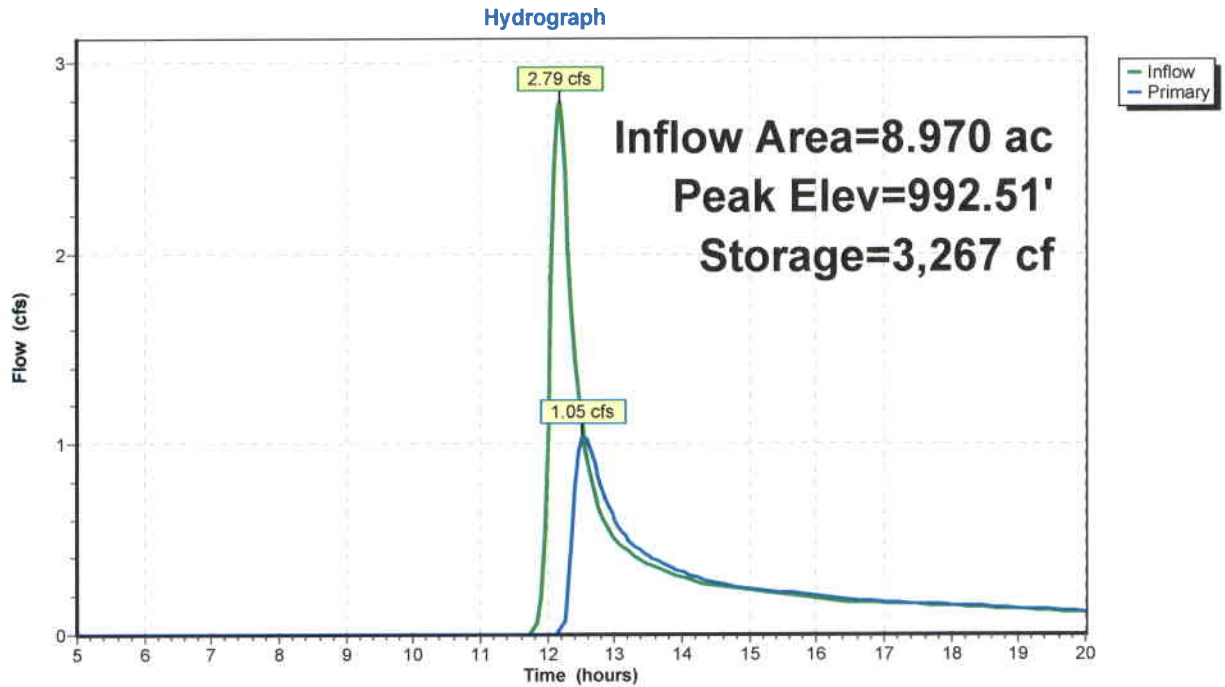
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 16

**Pond 1P: Existing Wetlands-Reduced**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 17

**Summary for Pond 2P: Box Culvert**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 0.23" for 1-yr event  
 Inflow = 1.05 cfs @ 12.53 hrs, Volume= 0.173 af  
 Outflow = 0.97 cfs @ 12.64 hrs, Volume= 0.171 af, Atten= 7%, Lag= 6.6 min  
 Primary = 0.97 cfs @ 12.64 hrs, Volume= 0.171 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.10' @ 12.64 hrs Surf.Area= 3,812 sf Storage= 366 cf

Plug-Flow detention time= 9.1 min calculated for 0.171 af (98% of inflow)  
 Center-of-Mass det. time= 5.5 min ( 898.1 - 892.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	992.00'	4,045 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
992.00	3,730	0	0
992.50	4,150	1,970	1,970
993.00	4,150	2,075	4,045

Device	Routing	Invert	Outlet Devices
#1	Primary	992.00'	<b>120.0" W x 12.0" H Box Culvert</b> L= 150.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 992.00' / 0.00' S= 6.6133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 10.00 sf

**Primary OutFlow** Max=0.97 cfs @ 12.64 hrs HW=992.10' TW=990.29' (Dynamic Tailwater)  
**1=Culvert** (Inlet Controls 0.97 cfs @ 1.00 fps)

## Proposed

Prepared by Microsoft

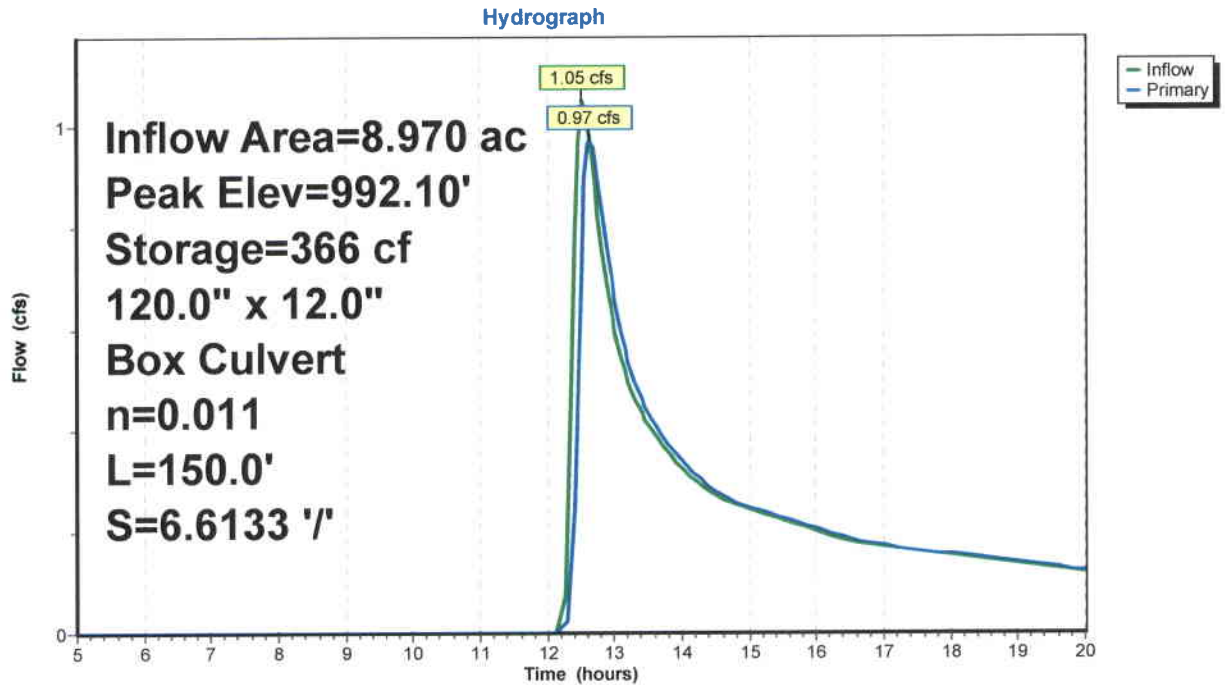
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 18

### Pond 2P: Box Culvert





**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 19

**Summary for Pond 3P: Stormwater Wetland**

Inflow Area = 24.620 ac, 22.58% Impervious, Inflow Depth > 0.34" for 1-yr event  
 Inflow = 8.00 cfs @ 12.10 hrs, Volume= 0.703 af  
 Outflow = 0.31 cfs @ 20.00 hrs, Volume= 0.181 af, Atten= 96%, Lag= 473.8 min  
**Primary = 0.31 cfs @ 20.00 hrs, Volume= 0.181 af**  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 990.56' @ 20.00 hrs Surf.Area= 41,431 sf Storage= 22,732 cf

Plug-Flow detention time= 257.2 min calculated for 0.181 af (26% of inflow)  
 Center-of-Mass det. time= 136.1 min ( 982.4 - 846.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	990.00'	162,573 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
990.00	39,265	0	0
993.00	50,800	135,098	135,098
993.50	59,100	27,475	162,573

Device	Routing	Invert	Outlet Devices
#1	Primary	990.00'	<b>18.0" Round Culvert x3 X 3.00</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 990.00' / 989.75' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	990.00'	<b>3.0" Vert. Orificex2 X 2.00</b> C= 0.600
#3	Device 1	992.00'	<b>36.0" x 36.0" Horiz. Grate#1 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#4	Device 1	992.00'	<b>36.0" x 72.0" Horiz. Grate#2 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	993.00'	<b>75.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.31 cfs @ 20.00 hrs HW=990.56' TW=0.00' (Dynamic Tailwater)

- 1=Culvert x3 (Passes 0.31 cfs of 3.27 cfs potential flow)
- 2=Orificex2 (Orifice Controls 0.31 cfs @ 3.19 fps)
- 3=Grate#1 ( Controls 0.00 cfs)
- 4=Grate#2 ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=990.00' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

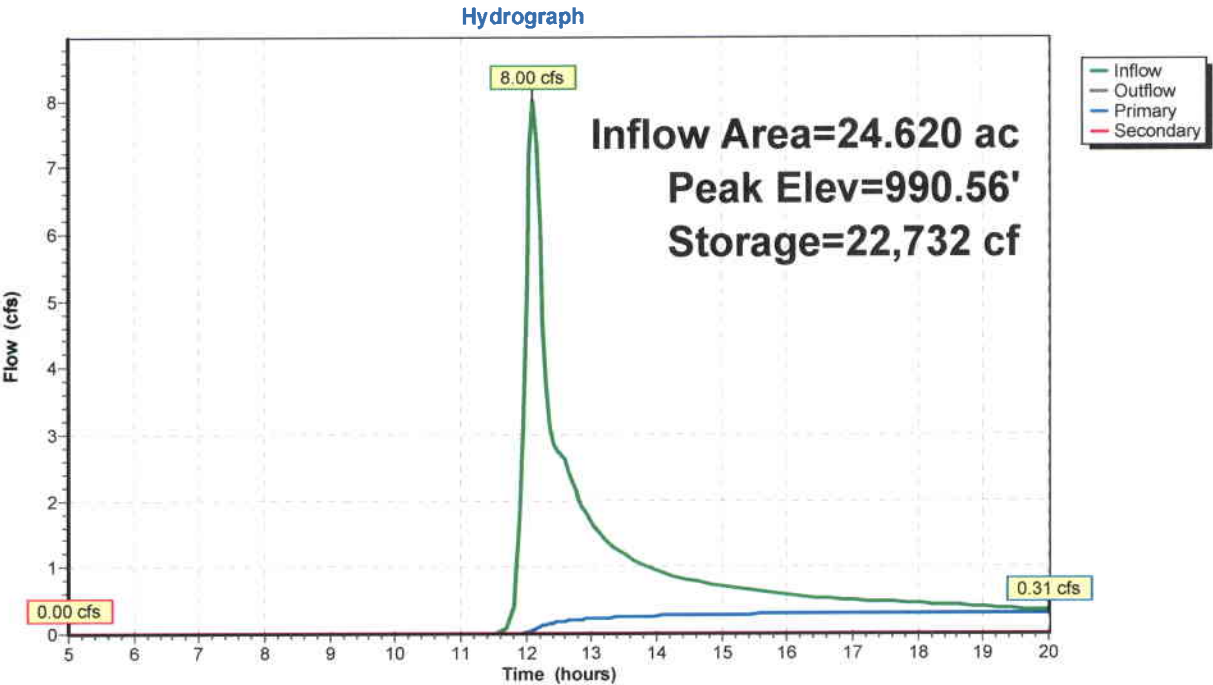
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 20

**Pond 3P: Stormwater Wetland**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 21

**Summary for Pond 4P: Wetland #2**

Inflow Area = 1.000 ac, 8.00% Impervious, Inflow Depth > 0.02" for 1-yr event  
 Inflow = 0.00 cfs @ 17.70 hrs, Volume= 0.001 af  
 Outflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Atten= 86%, Lag= 138.1 min  
 Primary = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 991.01' @ 20.00 hrs Surf.Area= 4,112 sf Storage= 54 cf

Plug-Flow detention time= 287.8 min calculated for 0.000 af (5% of inflow)  
 Center-of-Mass det. time= 94.5 min ( 1,108.0 - 1,013.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.00'	10,083 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.00	4,100	0	0
992.00	5,025	4,563	4,563
993.00	6,015	5,520	10,083

Device	Routing	Invert	Outlet Devices
#1	Primary	991.00'	<b>8.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 991.00' / 990.50' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	991.00'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	991.75'	<b>36.0" x 36.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	993.00'	<b>100.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.00 cfs @ 20.00 hrs HW=991.01' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.00 cfs of 0.00 cfs potential flow)  
 2=Orifice (Orifice Controls 0.00 cfs @ 0.39 fps)  
 3=Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=991.00' (Free Discharge)

4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

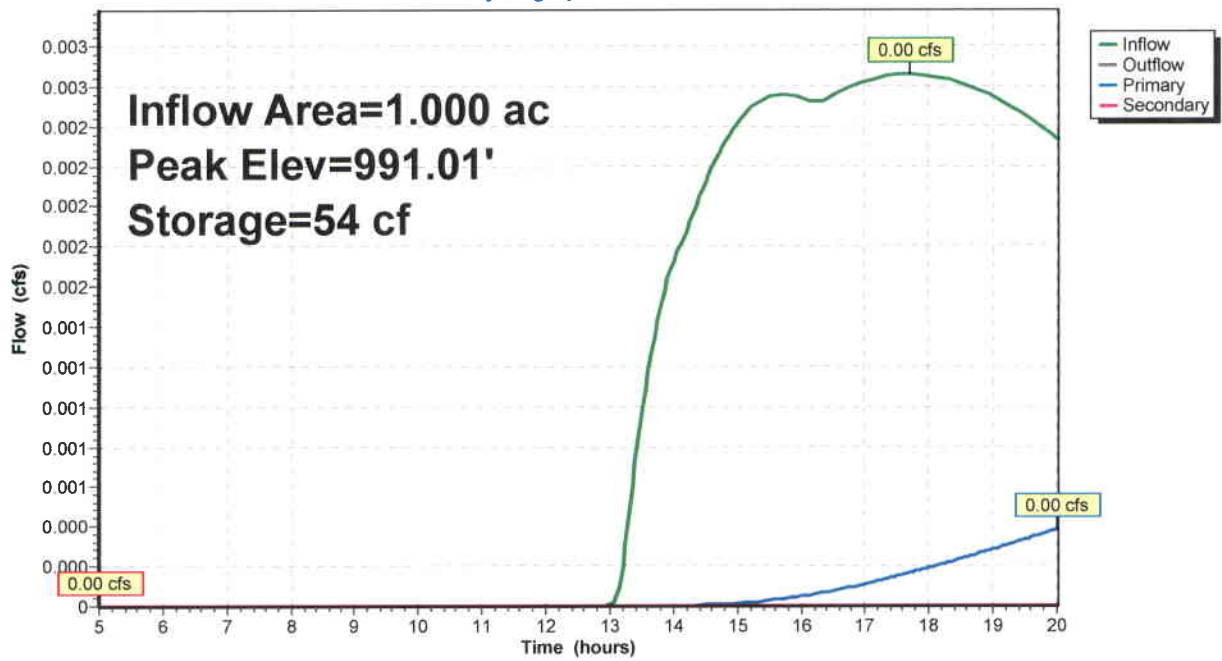
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 22

### Pond 4P: Wetland #2

#### Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 23

**Summary for Pond 5P: Underground Detention**

Inflow Area = 0.170 ac, 88.24% Impervious, Inflow Depth > 1.27" for 1-yr event  
 Inflow = 0.38 cfs @ 11.97 hrs, Volume= 0.018 af  
**Outflow = 0.15 cfs @ 12.09 hrs, Volume= 0.018 af, Atten= 60%, Lag= 7.2 min**  
 Primary = 0.15 cfs @ 12.09 hrs, Volume= 0.018 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 981.10' @ 12.09 hrs Surf.Area= 0.012 ac Storage= 0.005 af

Plug-Flow detention time= 17.2 min calculated for 0.018 af (99% of inflow)  
 Center-of-Mass det. time= 14.4 min ( 779.3 - 764.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	980.55'	0.029 af	<b>30.0" Round Pipe Storage x 2</b> L= 130.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	980.55'	<b>15.0" Round Culvert</b> L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 980.55' / 979.30' S= 0.0156 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	980.55'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	982.95'	<b>2.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.15 cfs @ 12.09 hrs HW=981.10' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.15 cfs of 1.04 cfs potential flow)  
 2=Orifice (Orifice Controls 0.15 cfs @ 3.14 fps)  
 3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

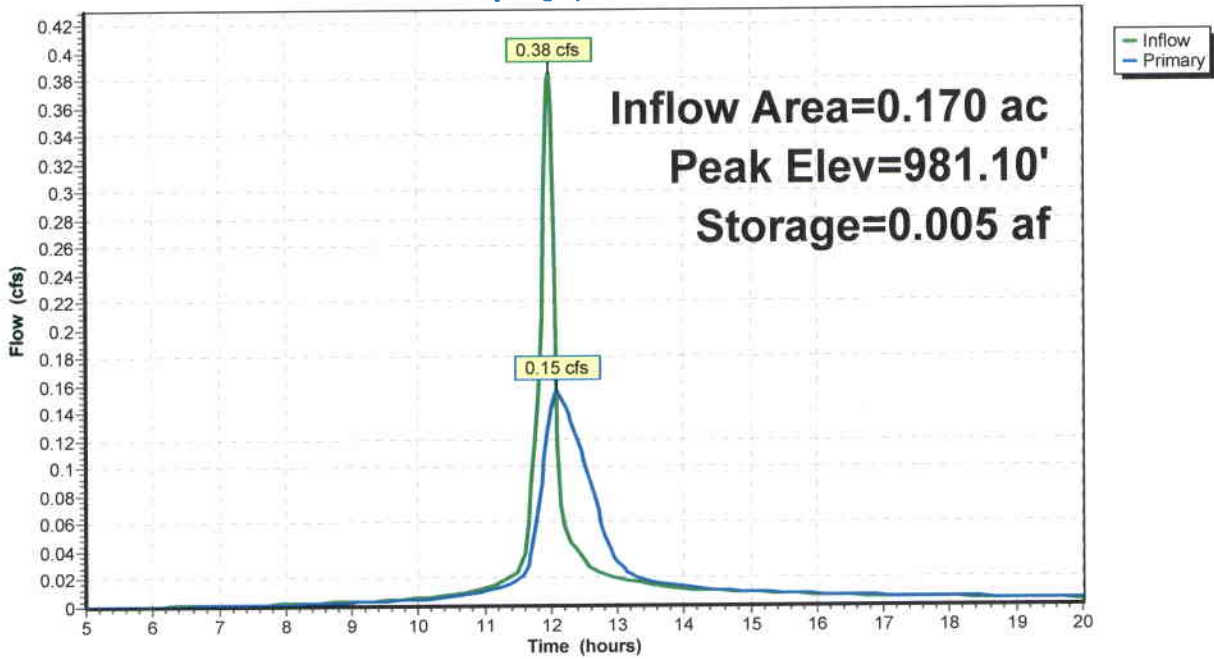
Type II 24-hr 1-yr Rainfall=1.96"

Printed 12/14/2017

Page 24

**Pond 5P: Underground Detention**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 25

**Summary for Subcatchment 1S: WS #1A**

Runoff = 11.42 cfs @ 12.14 hrs, Volume= 0.810 af, Depth&gt; 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.890	98	Paved parking, HSG D
0.260	30	Woods, Good, HSG A
1.580	77	Woods, Good, HSG D
1.100	39	>75% Grass cover, Good, HSG A
5.140	80	>75% Grass cover, Good, HSG D
8.970	75	Weighted Average
8.080		90.08% Pervious Area
0.890		9.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

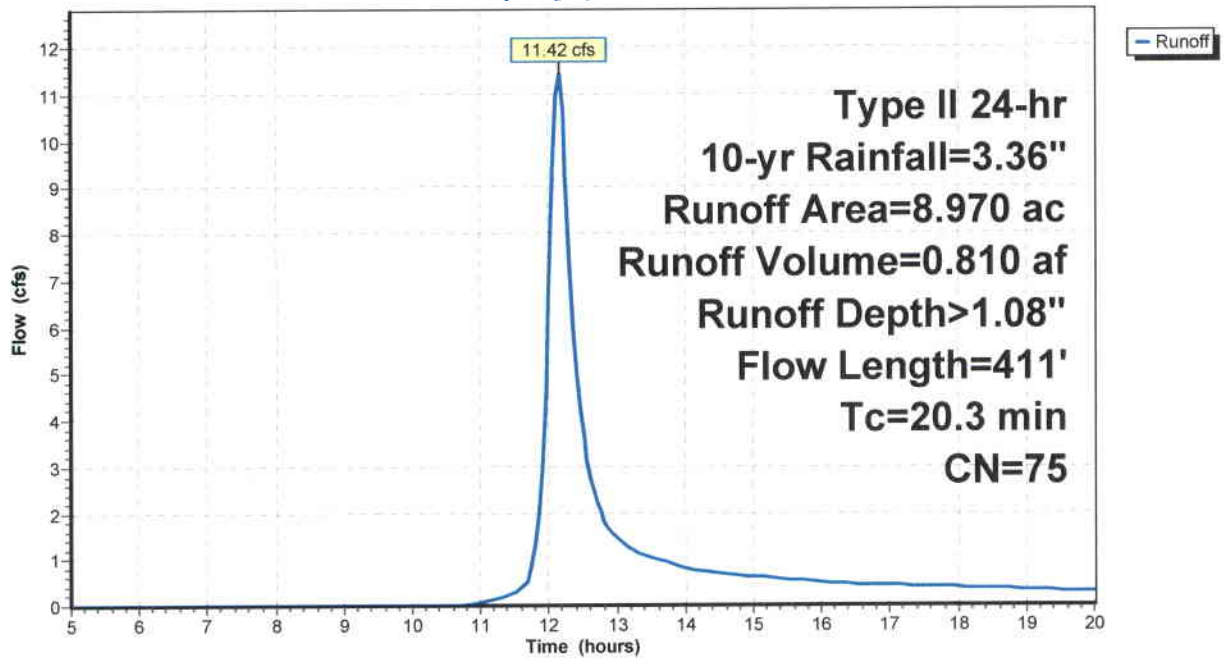
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 26

**Subcatchment 1S: WS #1A**

Hydrograph





**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 27

**Summary for Subcatchment 2S: WS #1B (CENTER)**

Runoff = 26.81 cfs @ 12.09 hrs, Volume= 1.650 af, Depth&gt; 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
4.670	98	Paved parking, HSG D
2.190	39	>75% Grass cover, Good, HSG A
0.210	61	>75% Grass cover, Good, HSG B
7.820	80	>75% Grass cover, Good, HSG D
0.470	30	Woods, Good, HSG A
0.290	77	Woods, Good, HSG D
15.650	78	Weighted Average
10.980		70.16% Pervious Area
4.670		29.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.5	62	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.3	60	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
2.7	250	0.0025	1.56	15.55	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=0.00' D=1.00' Z= 10.0 ' Top.W=20.00' n= 0.030 Short grass
0.1	77	0.0480	9.94	7.81	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.0	767	Total			

**Proposed**

Prepared by Microsoft

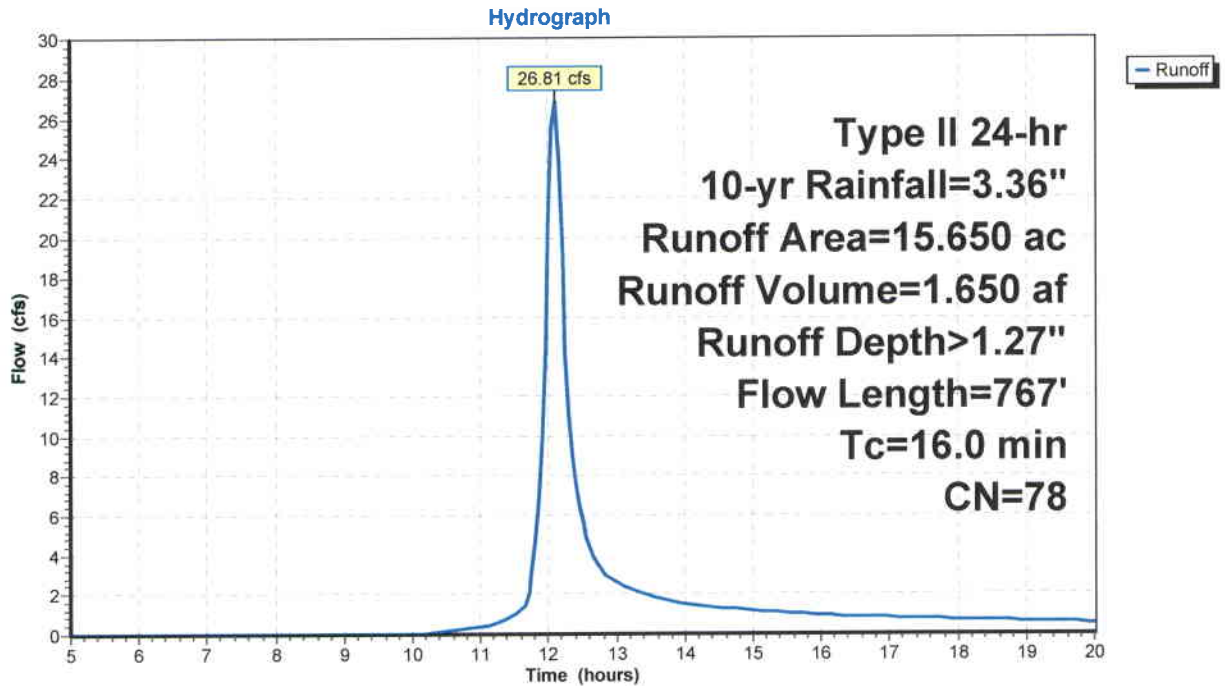
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 28

**Subcatchment 2S: WS #1B (CENTER)**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 29

**Summary for Subcatchment 3S: WS #1C**

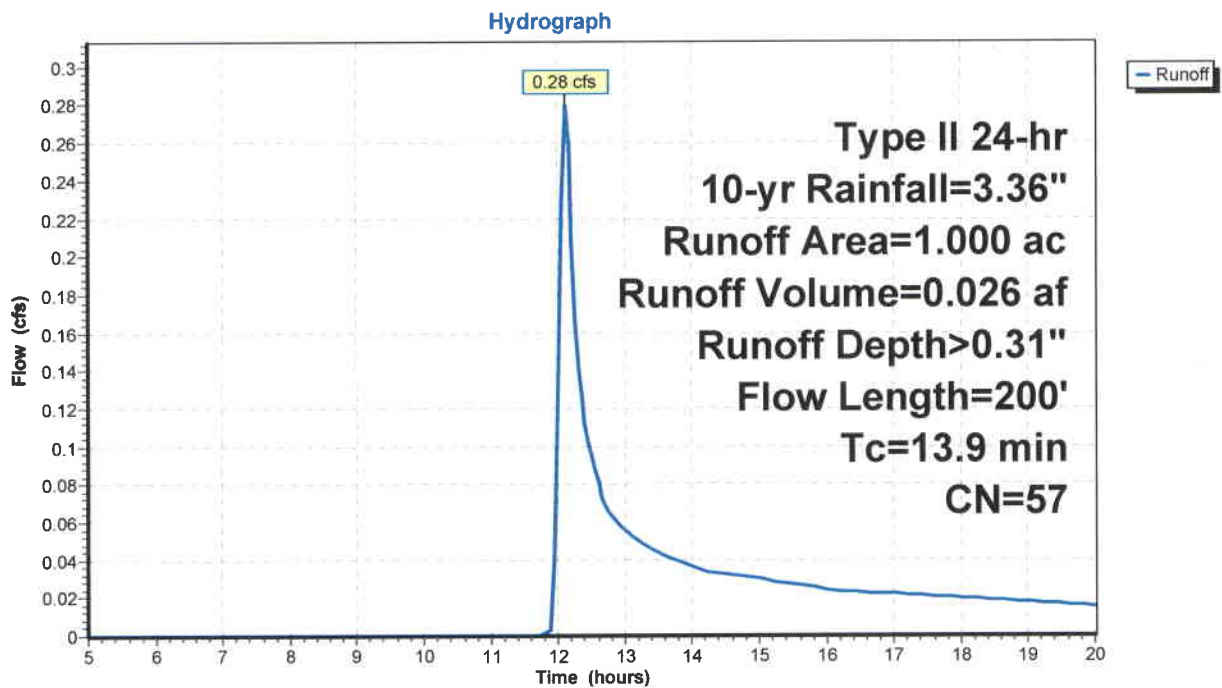
Runoff = 0.28 cfs @ 12.11 hrs, Volume= 0.026 af, Depth&gt; 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.080	98	Paved parking, HSG D
0.320	39	>75% Grass cover, Good, HSG A
0.600	61	>75% Grass cover, Good, HSG B
1.000	57	Weighted Average
0.920		92.00% Pervious Area
0.080		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	100	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.0	100	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
13.9	200	Total			

**Subcatchment 3S: WS #1C**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

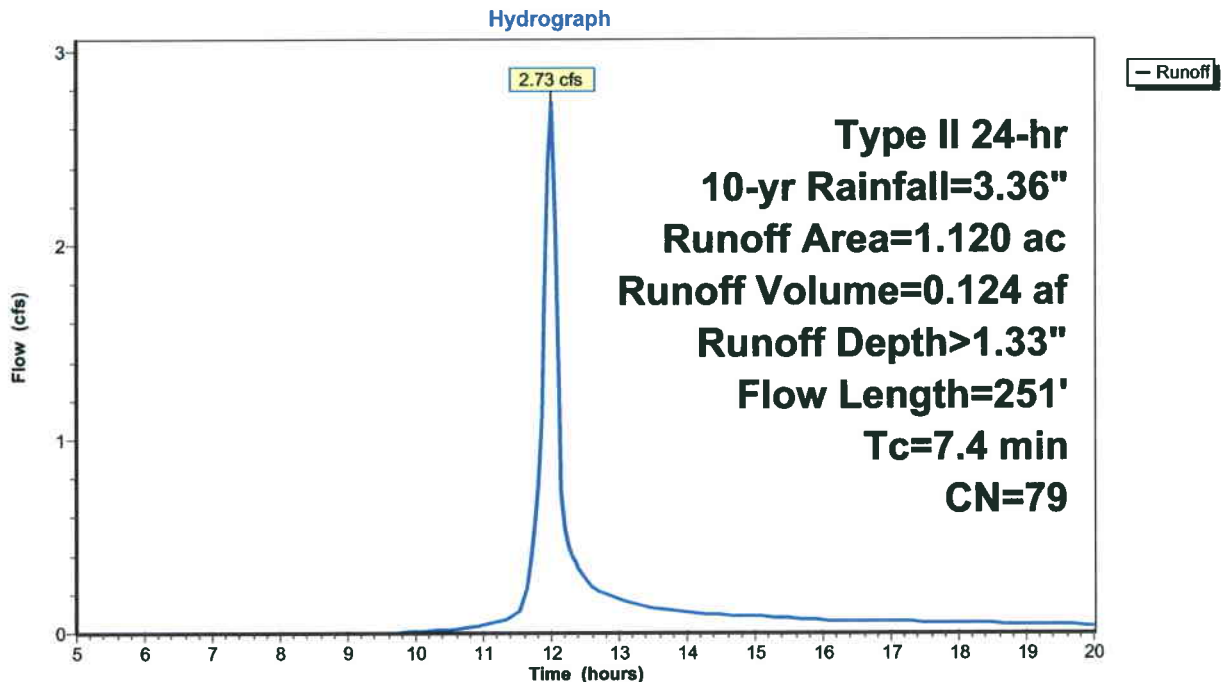
Page 30

**Summary for Subcatchment 4S: WS #1D****Runoff = 2.73 cfs @ 11.99 hrs, Volume= 0.124 af, Depth> 1.33"**Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.680	78	Meadow, non-grazed, HSG D
0.440	80	>75% Grass cover, Good, HSG D
1.120	79	Weighted Average
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0900	0.24		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
2.9	186	0.0044	1.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.4	251	Total			

**Subcatchment 4S: WS #1D**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 31

**Summary for Subcatchment 5S: WS #2A**

Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth&gt; 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
0.940	30	Woods, Good, HSG A
1.170	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.380	40	Weighted Average
2.230		93.70% Pervious Area
0.150		6.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	40	0.0250	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
12.3	60	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.4	95	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	90	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.8	533	Total			

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

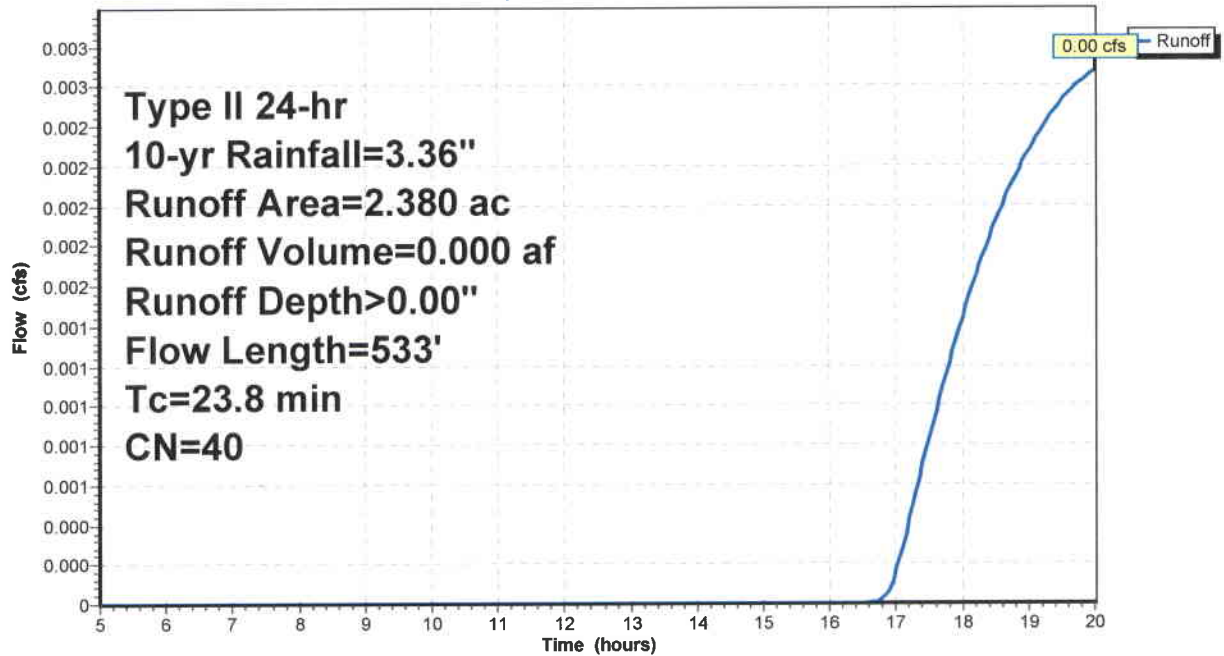
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 32

**Subcatchment 5S: WS #2A**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 33

**Summary for Subcatchment 6S: WS #2C**

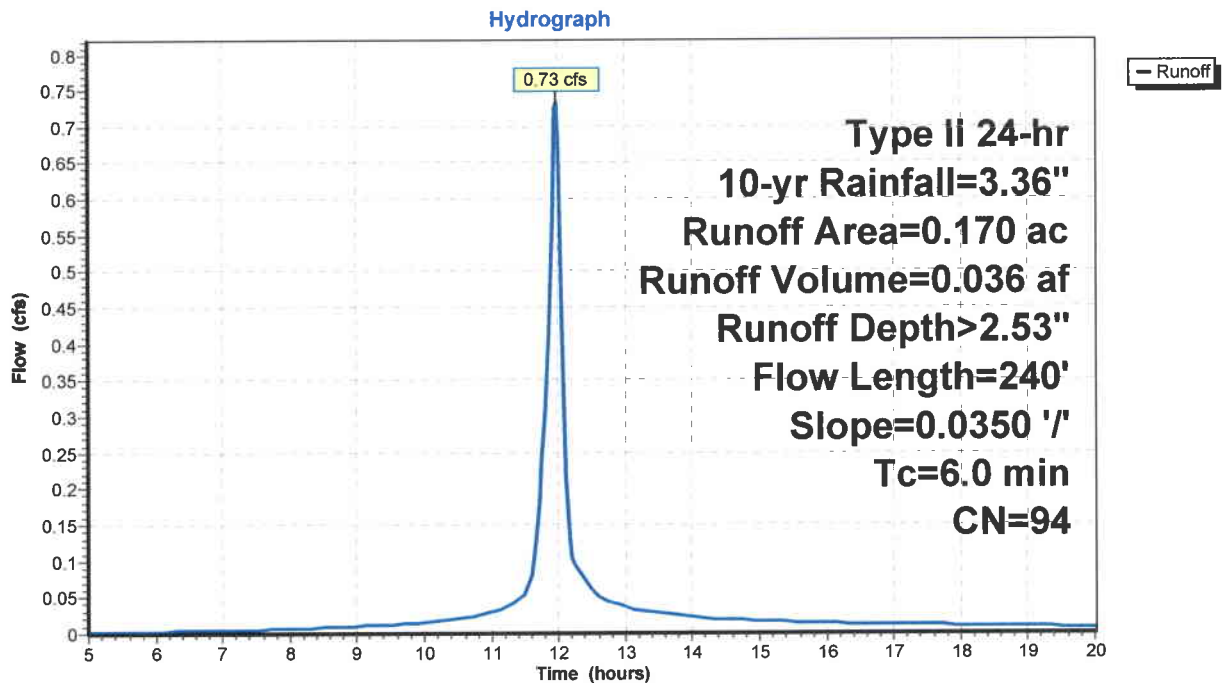
Runoff = 0.73 cfs @ 11.96 hrs, Volume= 0.036 af, Depth&gt; 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG B
0.020	61	>75% Grass cover, Good, HSG B
0.170	94	Weighted Average
0.020		11.76% Pervious Area
0.150		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0350	1.46		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
0.6	140	0.0350	3.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
4.3					<b>Direct Entry,</b>
6.0	240	Total			

**Subcatchment 6S: WS #2C**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 34

**Summary for Subcatchment 7S: WS #2B**

Runoff = 3.36 cfs @ 12.10 hrs, Volume= 0.224 af, Depth&gt; 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=3.36"

Area (ac)	CN	Description
0.850	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.350	39	>75% Grass cover, Good, HSG A
2.910	61	>75% Grass cover, Good, HSG B
4.210	66	Weighted Average
3.360		79.81% Pervious Area
0.850		20.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			



**Proposed**

Prepared by Microsoft

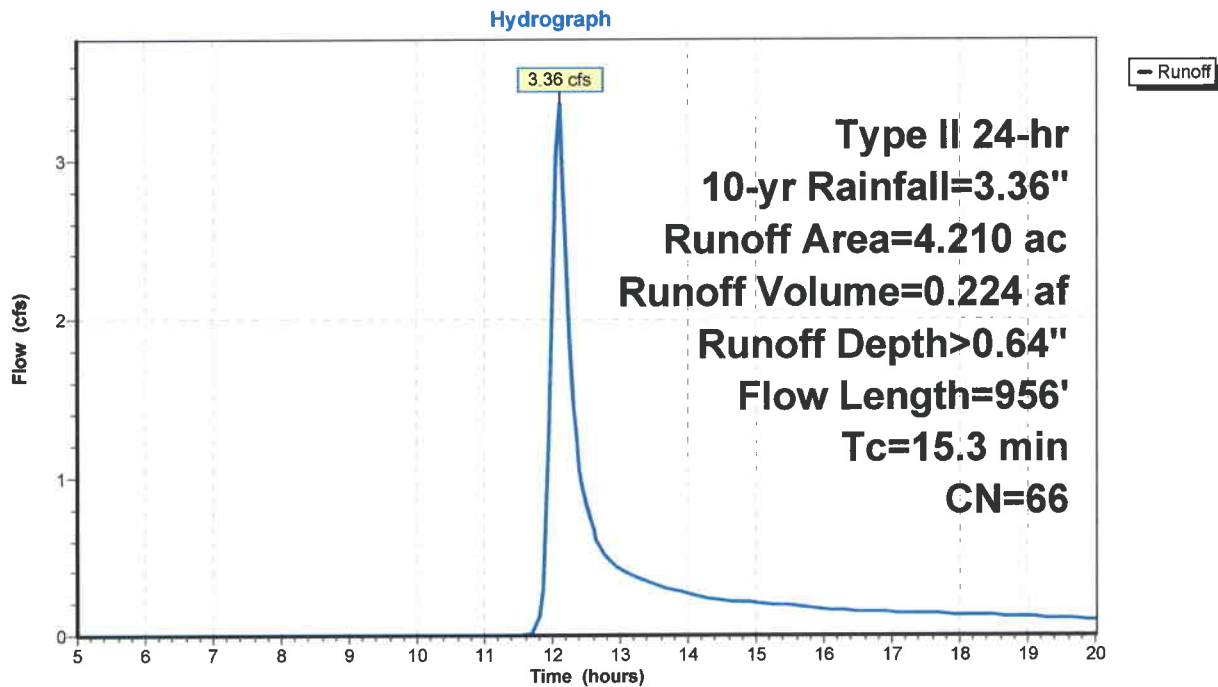
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 35

**Subcatchment 7S: WS #2B**



## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

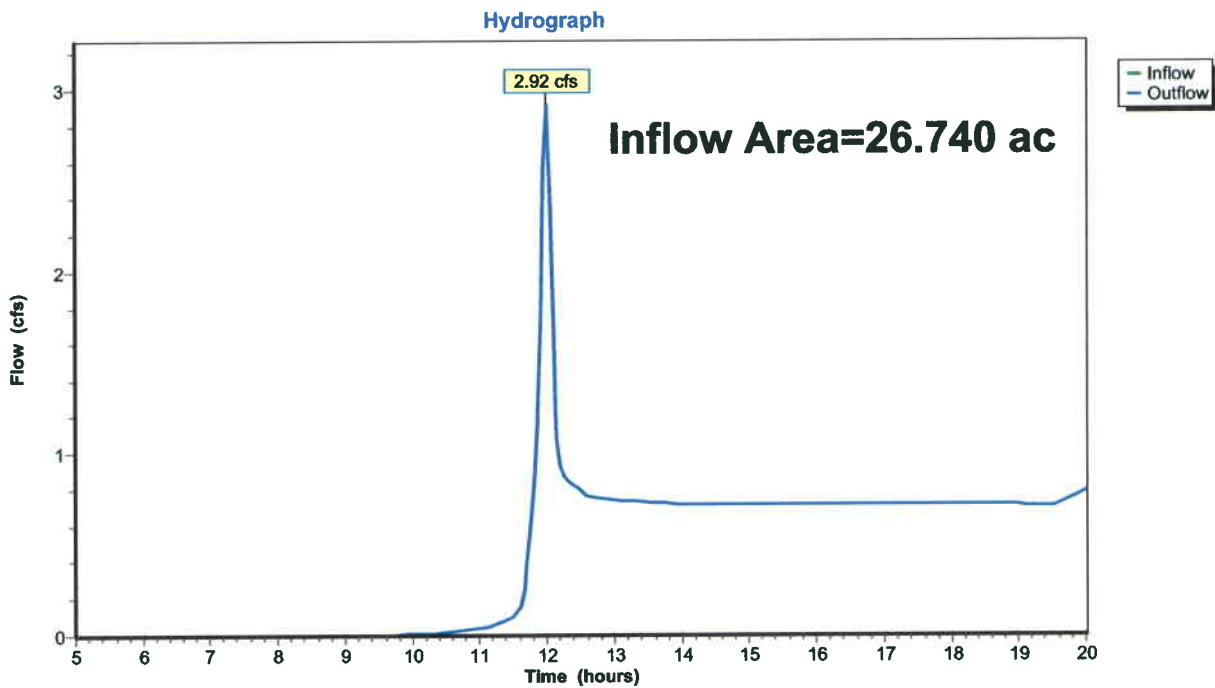
Page 36

### Summary for Reach 1R: WS #1 POA

Inflow Area = 26.740 ac, 21.09% Impervious, Inflow Depth > 0.24" for 10-yr event  
Inflow = 2.92 cfs @ 11.99 hrs, Volume= 0.542 af  
Outflow = 2.92 cfs @ 11.99 hrs, Volume= 0.542 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 1R: WS #1 POA



## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

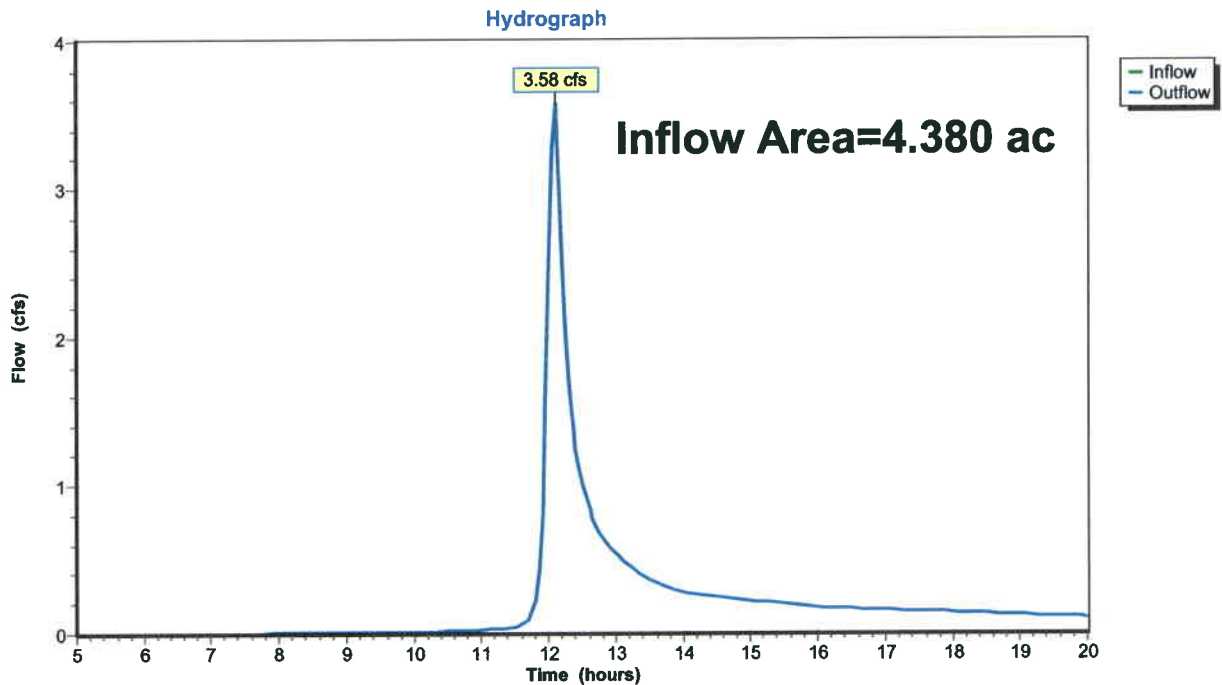
Page 37

### Summary for Reach 2R: WS #2B/C POA

Inflow Area = 4.380 ac, 22.83% Impervious, Inflow Depth > 0.71" for 10-yr event  
Inflow = 3.58 cfs @ 12.10 hrs, Volume= 0.259 af  
Outflow = 3.58 cfs @ 12.10 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 2R: WS #2B/C POA



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 38

**Summary for Pond 1P: Existing Wetlands-Reduced**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 1.08" for 10-yr event  
 Inflow = 11.42 cfs @ 12.14 hrs, Volume= 0.810 af  
 Outflow = 10.62 cfs @ 12.20 hrs, Volume= 0.745 af, Atten= 7%, Lag= 3.6 min  
 Primary = 10.62 cfs @ 12.20 hrs, Volume= 0.745 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.66' @ 12.20 hrs Surf.Area= 17,730 sf Storage= 5,479 cf

Plug-Flow detention time= 41.3 min calculated for 0.743 af (92% of inflow)  
 Center-of-Mass det. time= 14.3 min ( 829.3 - 815.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	21,366 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	30,390	10,602	13,769
993.25	30,390	7,598	21,366

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -26.27 -25.00 0.00 20.00 26.27 Height (feet) 0.58 0.13 0.00 0.13 0.58

**Primary OutFlow** Max=10.57 cfs @ 12.20 hrs HW=992.65' TW=992.46' (Dynamic Tailwater)  
 1=Asymmetrical Weir (Weir Controls 10.57 cfs @ 0.98 fps)

**Proposed**

Prepared by Microsoft

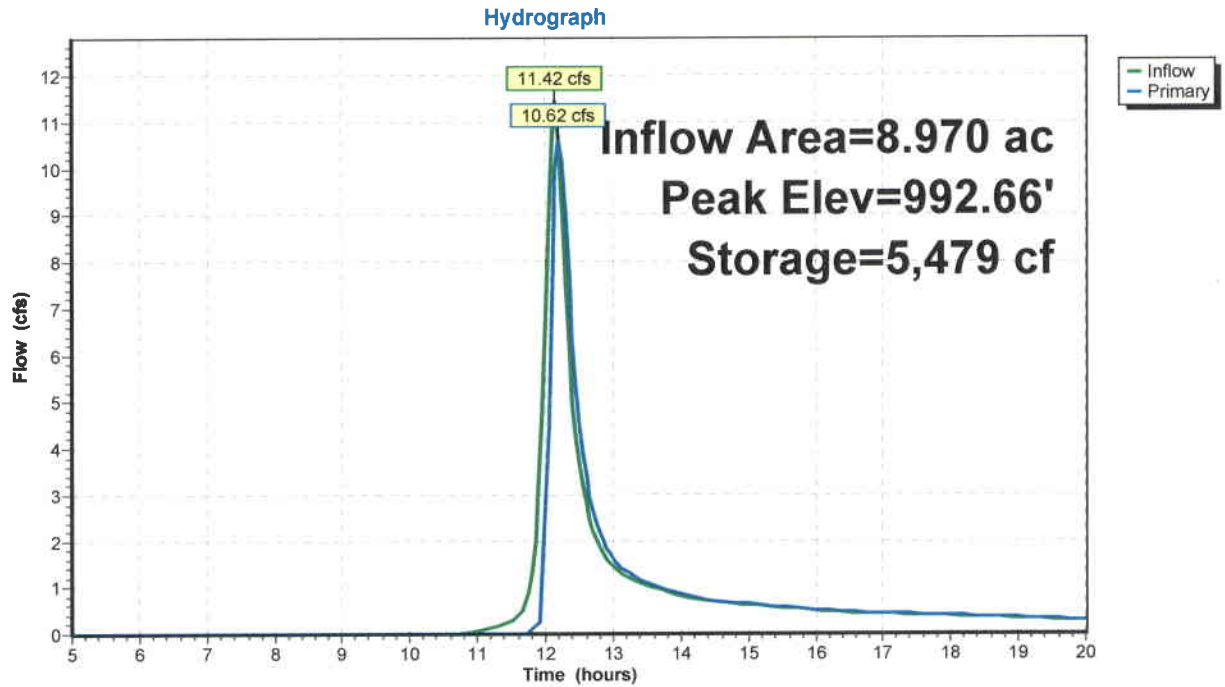
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 39

**Pond 1P: Existing Wetlands-Reduced**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 40

**Summary for Pond 2P: Box Culvert**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 1.00" for 10-yr event  
 Inflow = 10.62 cfs @ 12.20 hrs, Volume= 0.745 af  
 Outflow = 10.28 cfs @ 12.25 hrs, Volume= 0.738 af, Atten= 3%, Lag= 2.5 min  
 Primary = 10.28 cfs @ 12.25 hrs, Volume= 0.738 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.47' @ 12.25 hrs Surf.Area= 4,123 sf Storage= 1,838 cf

Plug-Flow detention time= 6.3 min calculated for 0.735 af (99% of inflow)  
 Center-of-Mass det. time= 2.7 min ( 832.1 - 829.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	992.00'	4,045 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
992.00	3,730	0	0
992.50	4,150	1,970	1,970
993.00	4,150	2,075	4,045

Device	Routing	Invert	Outlet Devices
#1	Primary	992.00'	<b>120.0" W x 12.0" H Box Culvert</b> L= 150.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 992.00' / 0.00' S= 6.6133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 10.00 sf

**Primary OutFlow** Max=10.24 cfs @ 12.25 hrs HW=992.47' TW=990.88' (Dynamic Tailwater)

1=Culvert (Inlet Controls 10.24 cfs @ 2.19 fps)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

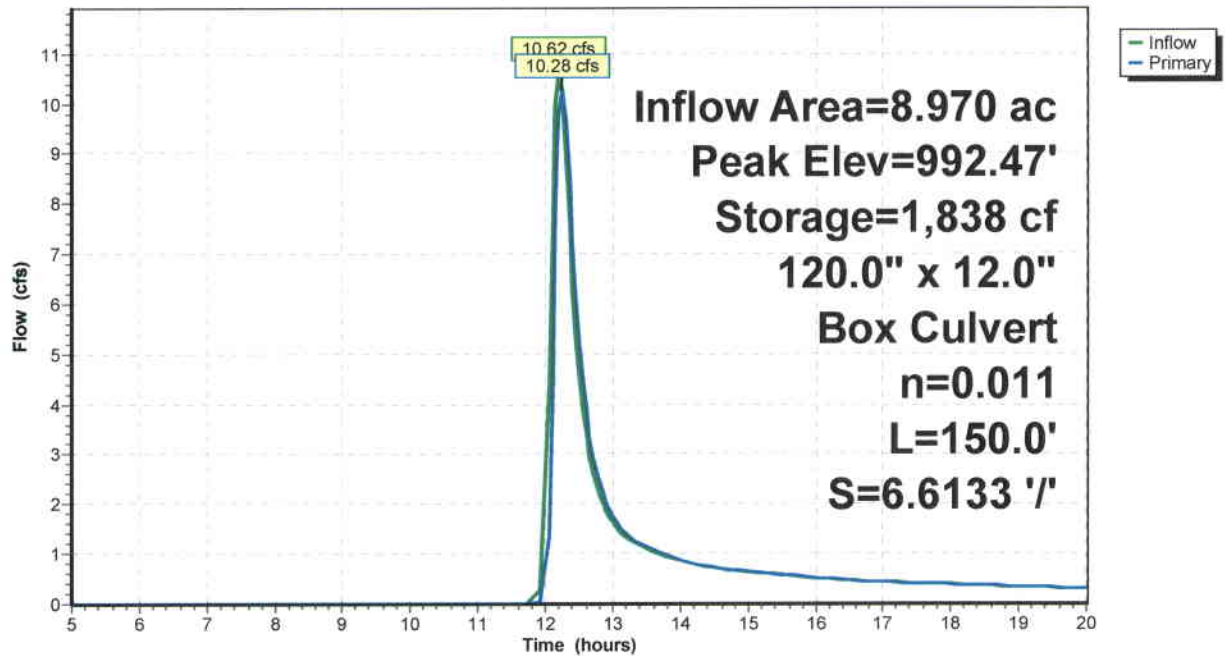
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 41

**Pond 2P: Box Culvert**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 42

**Summary for Pond 3P: Stormwater Wetland**

Inflow Area = 24.620 ac, 22.58% Impervious, Inflow Depth > 1.16" for 10-yr event  
 Inflow = 31.87 cfs @ 12.13 hrs, Volume= 2.388 af  
**Outflow = 0.73 cfs @ 20.00 hrs, Volume= 0.402 af**, Atten= 98%, Lag= 472.1 min  
 Primary = 0.73 cfs @ 20.00 hrs, Volume= 0.402 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.01' @ 20.00 hrs Surf.Area= 46,977 sf Storage= 86,490 cf

Plug-Flow detention time= 260.5 min calculated for 0.402 af (17% of inflow)  
 Center-of-Mass det. time= 158.5 min ( 972.0 - 813.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	990.00'	162,573 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
990.00	39,265	0	0
993.00	50,800	135,098	135,098
993.50	59,100	27,475	162,573

Device	Routing	Invert	Outlet Devices
#1	Primary	990.00'	<b>18.0" Round Culvert x3 X 3.00</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 990.00' / 989.75' S= 0.0050 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	990.00'	<b>3.0" Vert. Orificex2 X 2.00</b> C= 0.600
#3	Device 1	992.00'	<b>36.0" x 36.0" Horiz. Grate#1 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#4	Device 1	992.00'	<b>36.0" x 72.0" Horiz. Grate#2 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	993.00'	<b>75.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.73 cfs @ 20.00 hrs HW=992.01' TW=0.00' (Dynamic Tailwater)

- 1=Culvert x3 (Passes 0.73 cfs of 22.05 cfs potential flow)
- 2=Orificex2 (Orifice Controls 0.65 cfs @ 6.60 fps)
- 3=Grate#1 (Weir Controls 0.03 cfs @ 0.25 fps)
- 4=Grate#2 (Weir Controls 0.05 cfs @ 0.25 fps)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=990.00' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

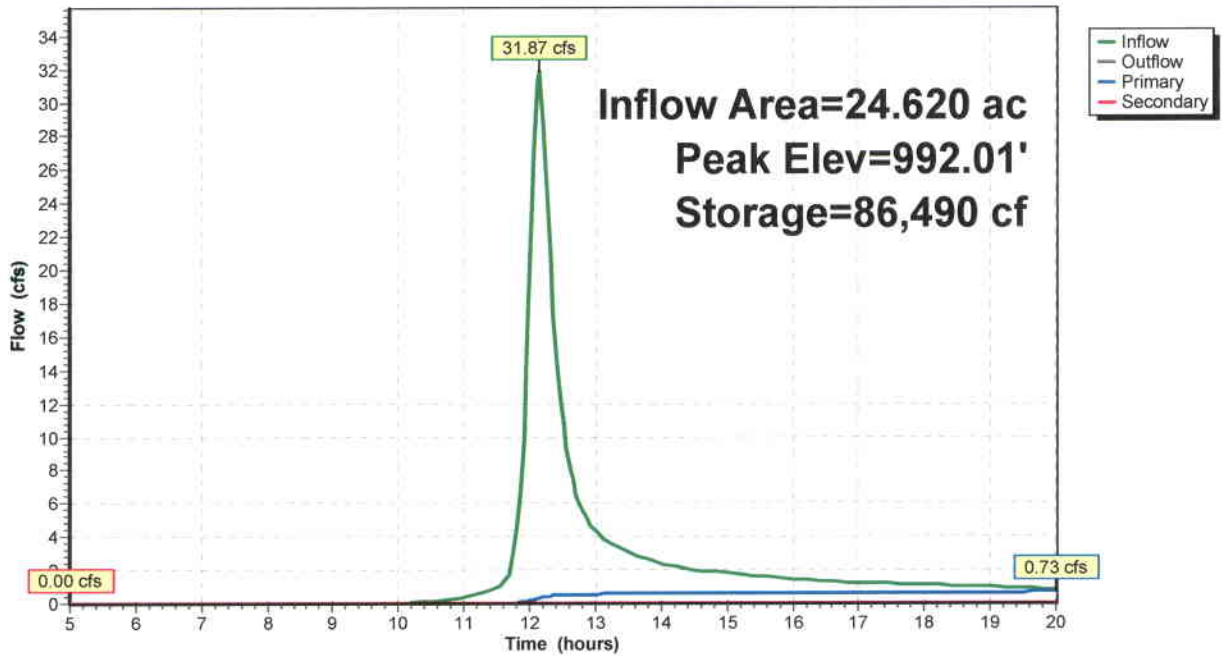
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 43

**Pond 3P: Stormwater Wetland**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 44

**Summary for Pond 4P: Wetland #2**

Inflow Area = 1.000 ac, 8.00% Impervious, Inflow Depth > 0.31" for 10-yr event  
 Inflow = 0.28 cfs @ 12.11 hrs, Volume= 0.026 af  
 Outflow = 0.03 cfs @ 15.30 hrs, Volume= 0.016 af, Atten= 90%, Lag= 191.2 min  
**Primary = 0.03 cfs @ 15.30 hrs, Volume= 0.016 af**  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 991.12' @ 15.30 hrs Surf.Area= 4,213 sf Storage= 506 cf

Plug-Flow detention time= 204.5 min calculated for 0.016 af (61% of inflow)  
 Center-of-Mass det. time= 107.4 min ( 972.3 - 864.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.00'	10,083 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.00	4,100	0	0
992.00	5,025	4,563	4,563
993.00	6,015	5,520	10,083

Device	Routing	Invert	Outlet Devices
#1	Primary	991.00'	<b>8.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 991.00' / 990.50' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	991.00'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	991.75'	<b>36.0" x 36.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	993.00'	<b>100.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.03 cfs @ 15.30 hrs HW=991.12' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.03 cfs of 0.04 cfs potential flow)  
 2=Orifice (Orifice Controls 0.03 cfs @ 1.19 fps)  
 3=Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=991.00' (Free Discharge)

4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

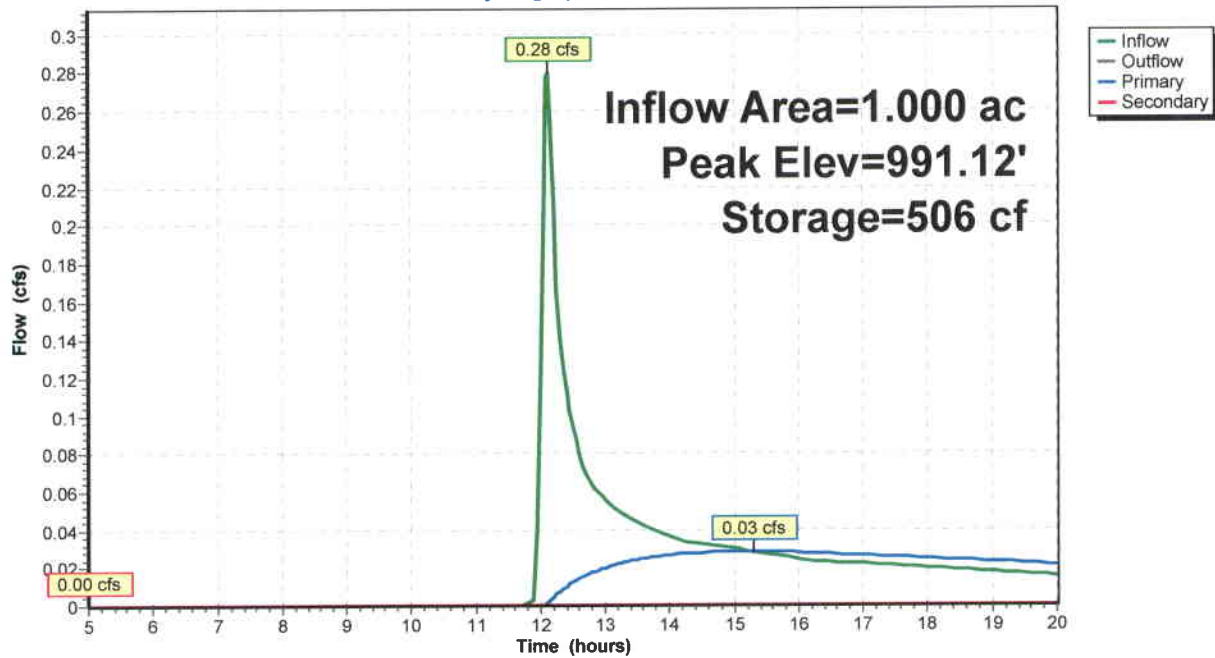
Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 45

**Pond 4P: Wetland #2**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 46

**Summary for Pond 5P: Underground Detention**

Inflow Area = 0.170 ac, 88.24% Impervious, Inflow Depth > 2.53" for 10-yr event  
 Inflow = 0.73 cfs @ 11.96 hrs, Volume= 0.036 af  
 Outflow = 0.22 cfs @ 12.11 hrs, Volume= 0.036 af, Atten= 70%, Lag= 8.7 min  
 Primary = 0.22 cfs @ 12.11 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 981.55' @ 12.11 hrs Surf.Area= 0.015 ac Storage= 0.011 af

Plug-Flow detention time= 21.6 min calculated for 0.036 af (99% of inflow)  
 Center-of-Mass det. time= 19.2 min ( 769.2 - 750.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	980.55'	0.029 af	<b>30.0" Round Pipe Storage x 2</b> L= 130.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	980.55'	<b>15.0" Round Culvert</b> L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 980.55' / 979.30' S= 0.0156 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	980.55'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	982.95'	<b>2.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.22 cfs @ 12.11 hrs HW=981.55' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.22 cfs of 2.82 cfs potential flow)  
 2=Orifice (Orifice Controls 0.22 cfs @ 4.50 fps)  
 3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

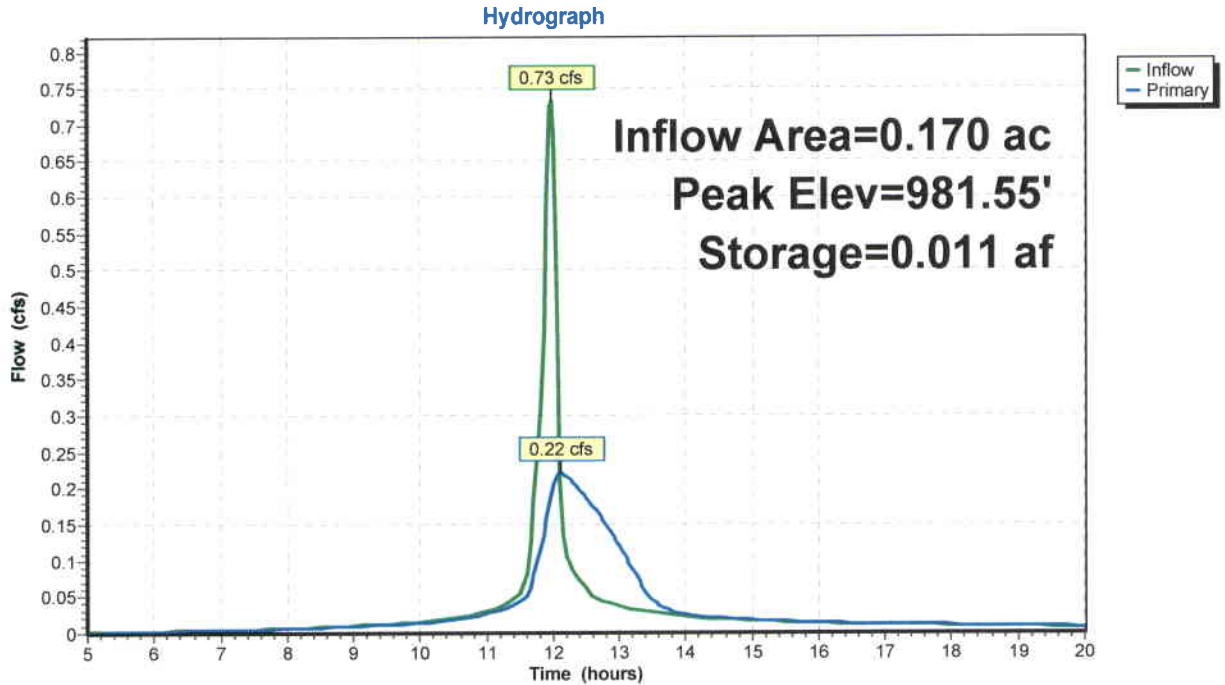
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 10-yr Rainfall=3.36"

Printed 12/14/2017

Page 47

**Pond 5P: Underground Detention**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 48

**Summary for Subcatchment 1S: WS #1A**

Runoff = 30.02 cfs @ 12.13 hrs, Volume= 2.096 af, Depth&gt; 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.890	98	Paved parking, HSG D
0.260	30	Woods, Good, HSG A
1.580	77	Woods, Good, HSG D
1.100	39	>75% Grass cover, Good, HSG A
5.140	80	>75% Grass cover, Good, HSG D
8.970	75	Weighted Average
8.080		90.08% Pervious Area
0.890		9.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	18	0.0100	0.63		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
13.0	82	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.9	171	0.0090	1.53		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	140	0.0090	0.47		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.3	411	Total			

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

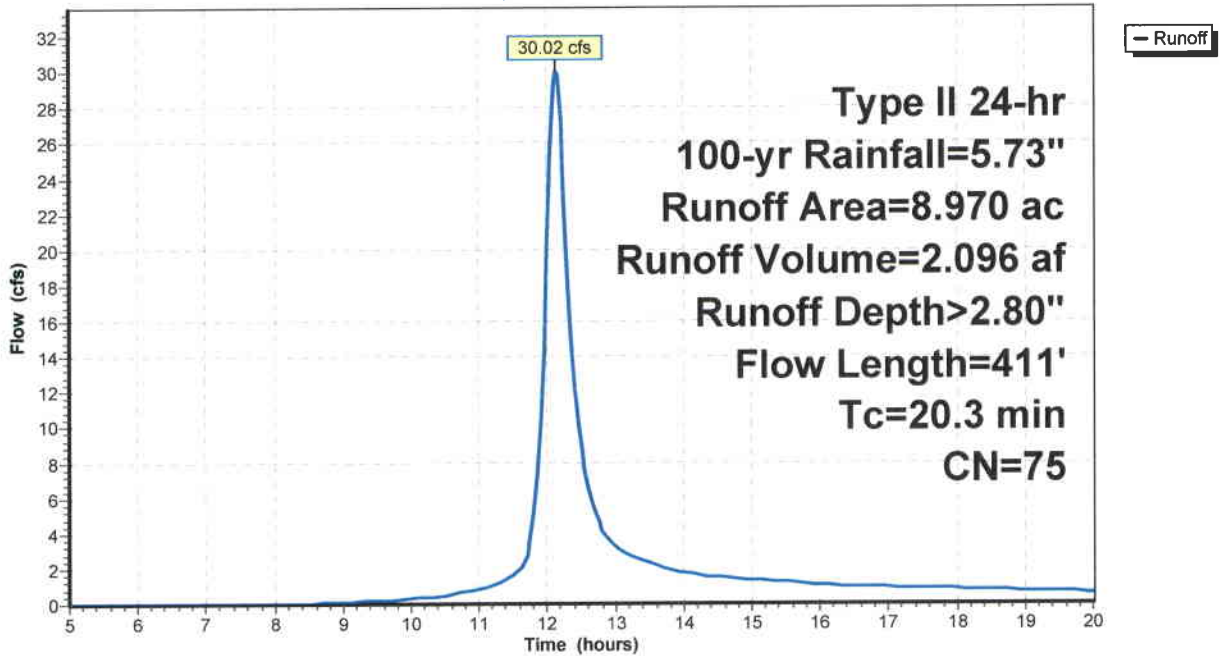
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 49

**Subcatchment 1S: WS #1A**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 50

**Summary for Subcatchment 2S: WS #1B (CENTER)**

Runoff = 64.95 cfs @ 12.08 hrs, Volume= 4.026 af, Depth&gt; 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
4.670	98	Paved parking, HSG D
2.190	39	>75% Grass cover, Good, HSG A
0.210	61	>75% Grass cover, Good, HSG B
7.820	80	>75% Grass cover, Good, HSG D
0.470	30	Woods, Good, HSG A
0.290	77	Woods, Good, HSG D
15.650	78	Weighted Average
10.980		70.16% Pervious Area
4.670		29.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	14	0.0100	0.60		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.31"
9.3	86	0.0250	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.7	218	0.0180	2.16		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.5	62	0.0180	0.67		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.3	60	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
2.7	250	0.0025	1.56	15.55	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=0.00' D=1.00' Z= 10.0 ' /' Top.W=20.00' n= 0.030 Short grass
0.1	77	0.0480	9.94	7.81	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.0	767	Total			



**Proposed**

Prepared by Microsoft

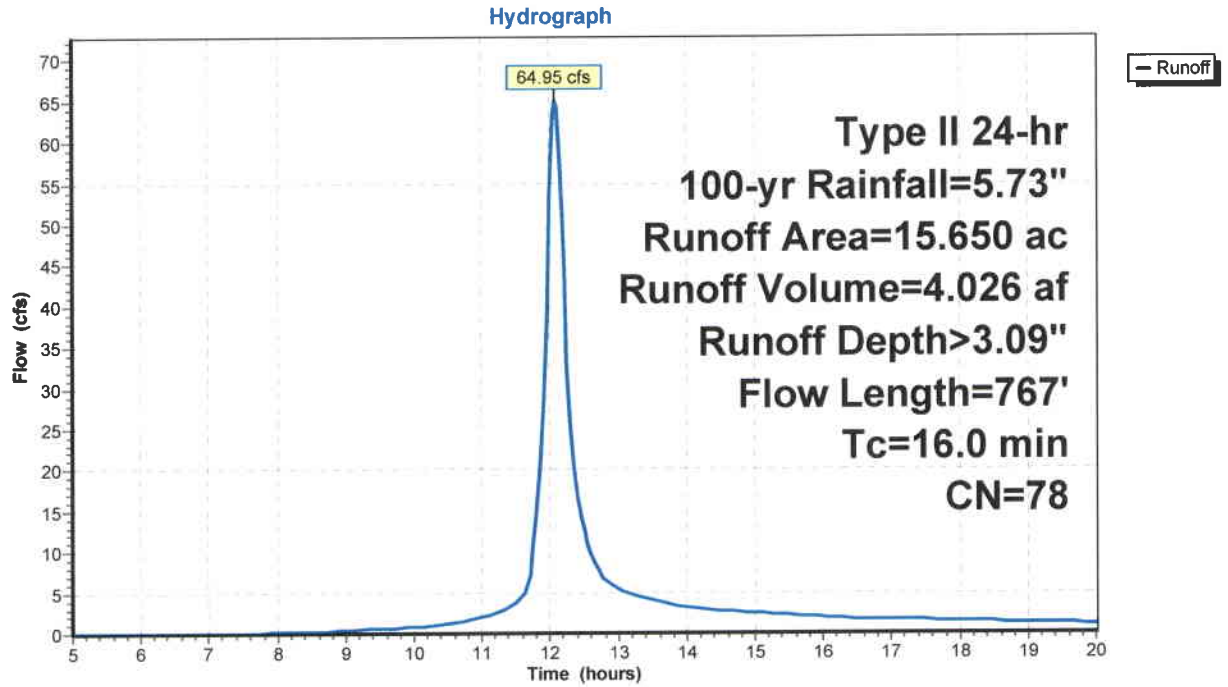
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 51

**Subcatchment 2S: WS #1B (CENTER)**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 52

**Summary for Subcatchment 3S: WS #1C**

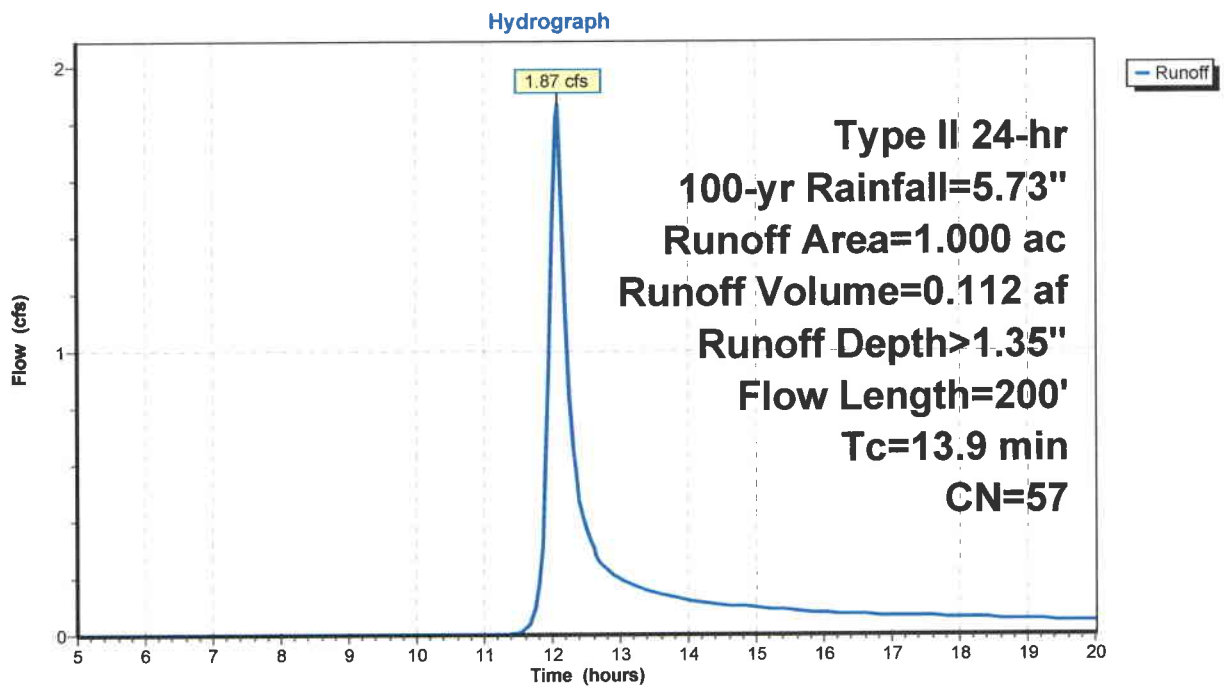
Runoff = 1.87 cfs @ 12.07 hrs, Volume= 0.112 af, Depth&gt; 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.080	98	Paved parking, HSG D
0.320	39	>75% Grass cover, Good, HSG A
0.600	61	>75% Grass cover, Good, HSG B
1.000	57	Weighted Average
0.920		92.00% Pervious Area
0.080		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	100	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.0	100	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
13.9	200	Total			

**Subcatchment 3S: WS #1C**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

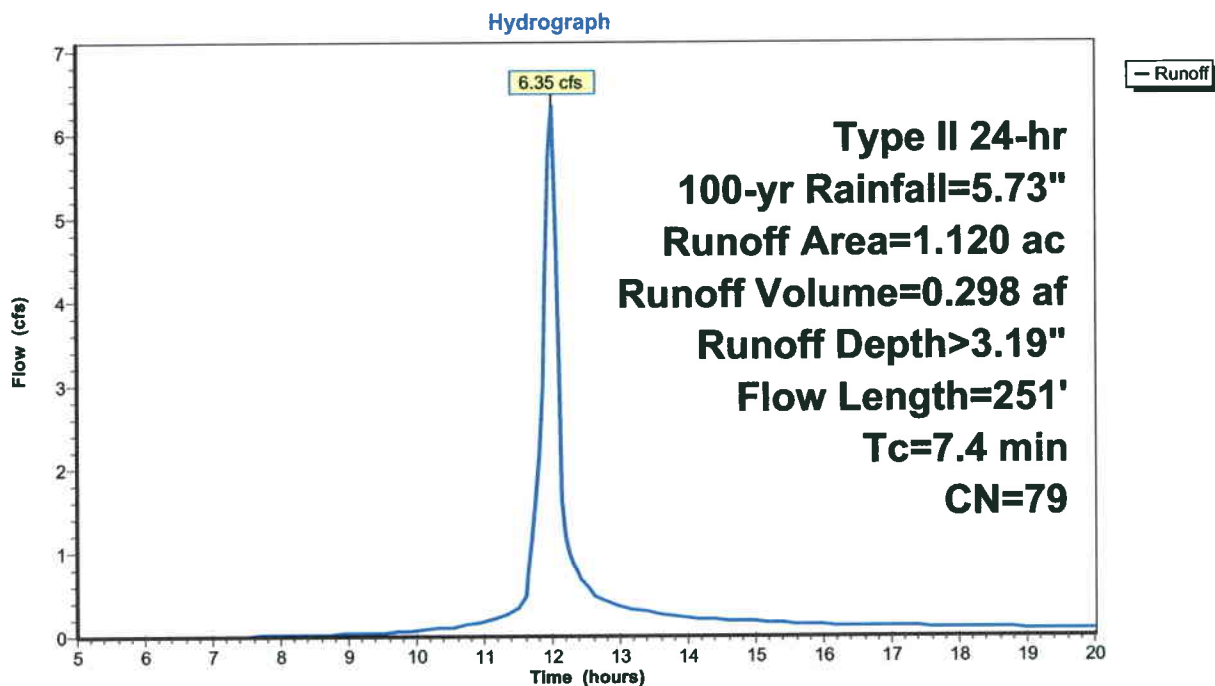
Page 53

**Summary for Subcatchment 4S: WS #1D****Runoff = 6.35 cfs @ 11.99 hrs, Volume= 0.298 af, Depth> 3.19"**Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.680	78	Meadow, non-grazed, HSG D
0.440	80	>75% Grass cover, Good, HSG D
1.120	79	Weighted Average
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0900	0.24		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
2.9	186	0.0044	1.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.4	251	Total			

**Subcatchment 4S: WS #1D**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 54

**Summary for Subcatchment 5S: WS #2A**

Runoff = 0.35 cfs @ 12.31 hrs, Volume= 0.067 af, Depth&gt; 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG D
0.940	30	Woods, Good, HSG A
1.170	39	>75% Grass cover, Good, HSG A
0.120	61	>75% Grass cover, Good, HSG B
2.380	40	Weighted Average
2.230		93.70% Pervious Area
0.150		6.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	40	0.0250	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
12.3	60	0.0440	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 2.31"
0.8	60	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.4	95	0.0660	4.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	90	0.0660	1.28		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
4.0	188	0.0240	0.77		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.8	533	Total			

**Proposed**

Prepared by Microsoft

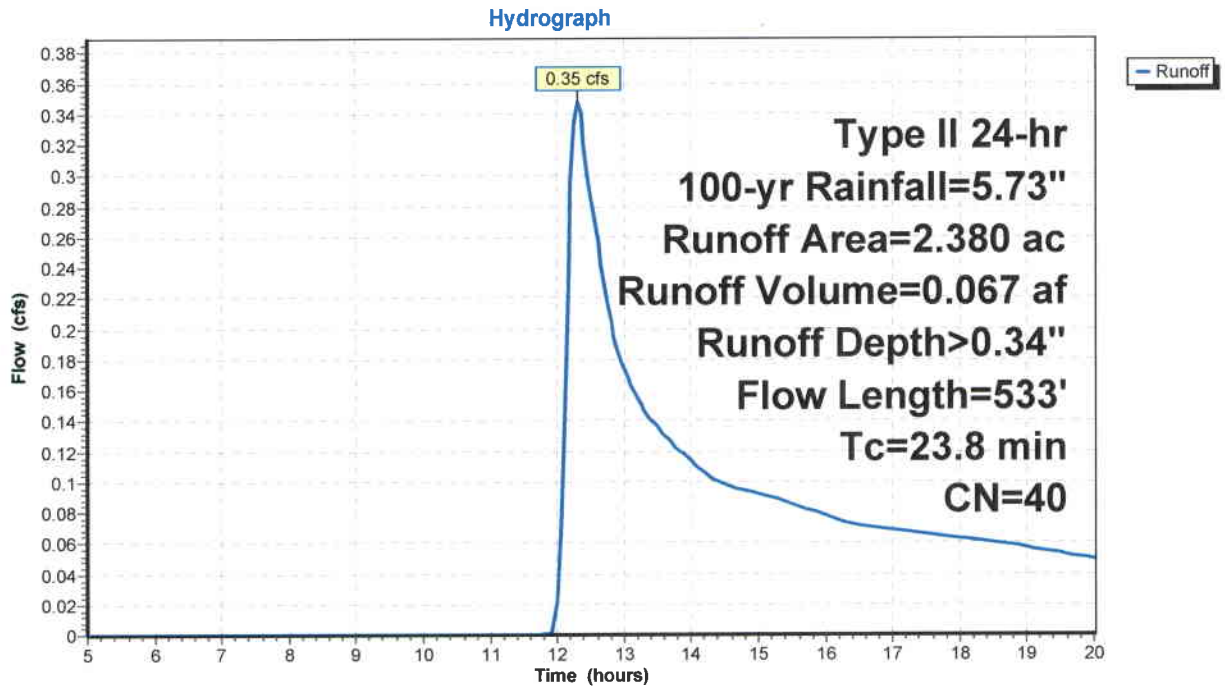
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 55

**Subcatchment 5S: WS #2A**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 56

**Summary for Subcatchment 6S: WS #2C**

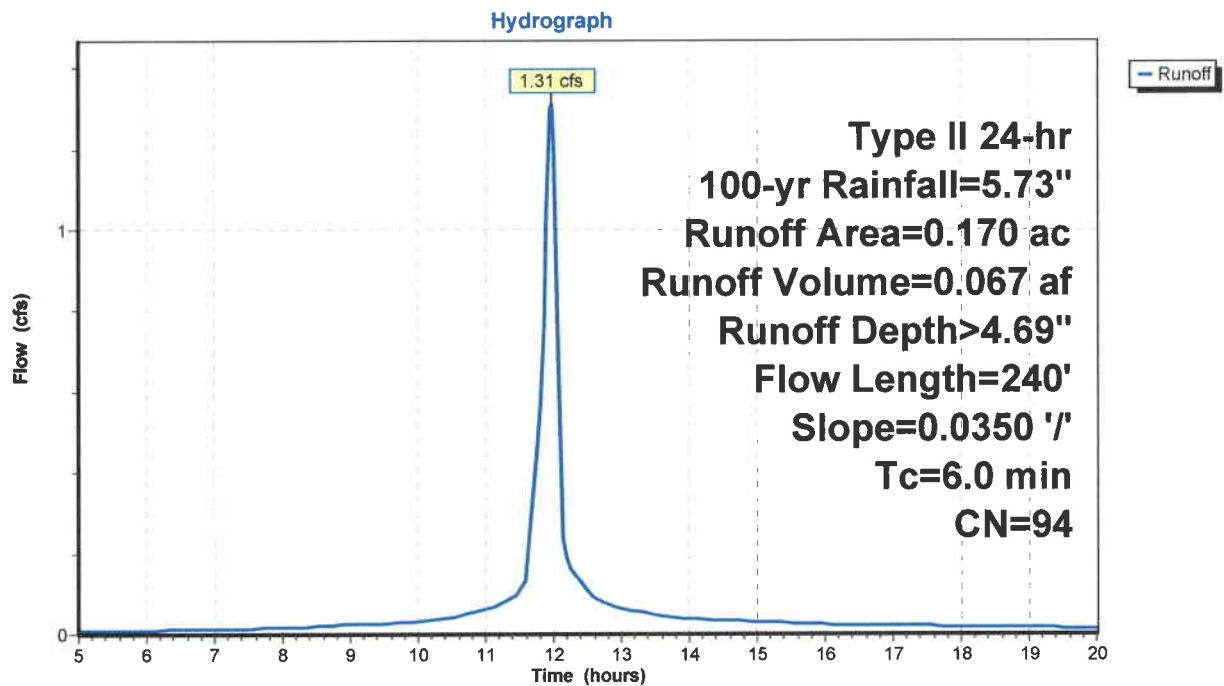
Runoff = 1.31 cfs @ 11.96 hrs, Volume= 0.067 af, Depth&gt; 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG B
0.020	61	>75% Grass cover, Good, HSG B
0.170	94	Weighted Average
0.020		11.76% Pervious Area
0.150		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0350	1.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.31"
0.6	140	0.0350	3.80		Shallow Concentrated Flow, Paved Kv= 20.3 fps
4.3					Direct Entry,
6.0	240	Total			

**Subcatchment 6S: WS #2C**

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 57

**Summary for Subcatchment 7S: WS #2B**

Runoff = 11.81 cfs @ 12.08 hrs, Volume= 0.713 af, Depth&gt; 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.73"

Area (ac)	CN	Description
0.850	98	Paved parking, HSG D
0.100	30	Woods, Good, HSG A
0.350	39	>75% Grass cover, Good, HSG A
2.910	61	>75% Grass cover, Good, HSG B
4.210	66	Weighted Average
3.360		79.81% Pervious Area
0.850		20.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0300	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.31"
1.3	180	0.0210	2.33		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.7	206	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.5	470	0.0100	3.09	5.46	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
15.3	956	Total			

**Proposed**

Prepared by Microsoft

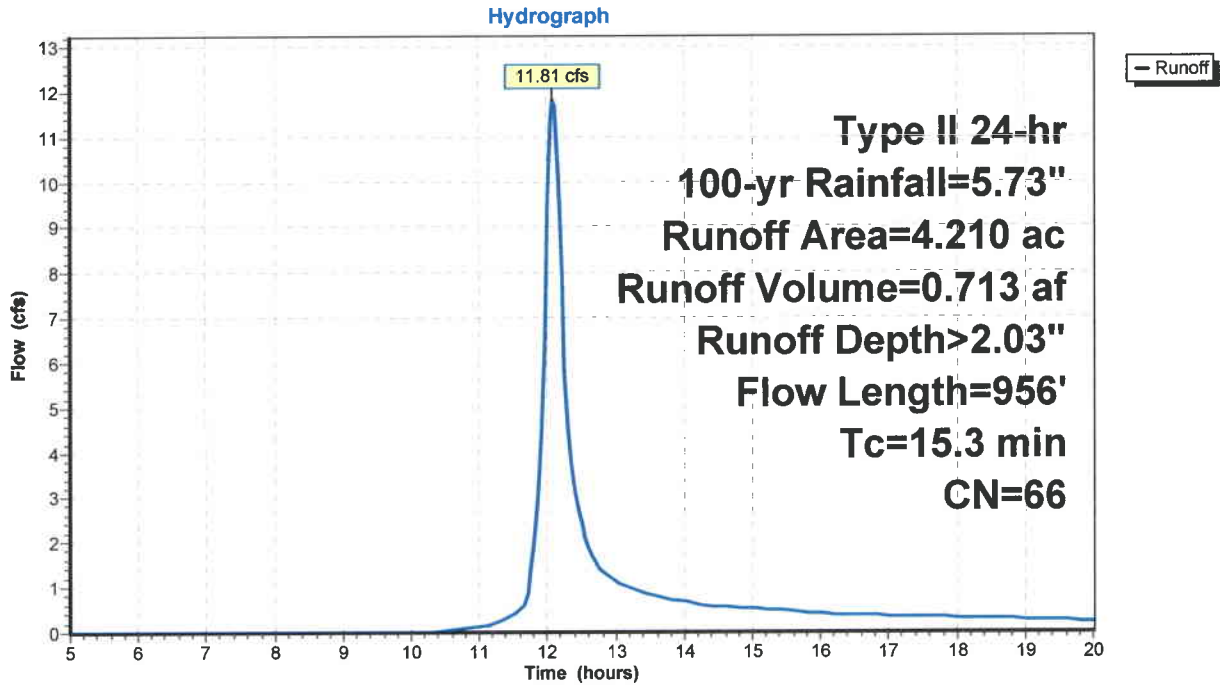
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 58

**Subcatchment 7S: WS #2B**





## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

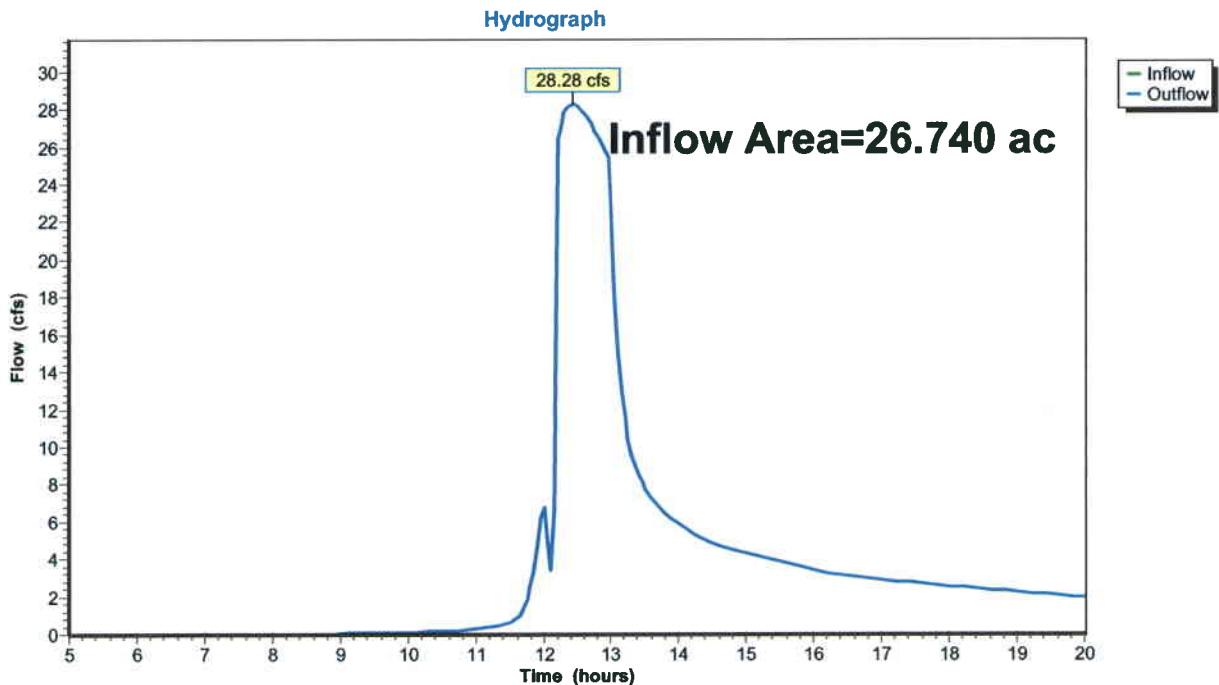
Page 59

### Summary for Reach 1R: WS #1 POA

Inflow Area = 26.740 ac, 21.09% Impervious, Inflow Depth > 1.98" for 100-yr event  
Inflow = 28.28 cfs @ 12.42 hrs, Volume= 4.412 af  
Outflow = 28.28 cfs @ 12.42 hrs, Volume= 4.412 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 1R: WS #1 POA



## Proposed

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 60

### Summary for Reach 2R: WS #2B/C POA

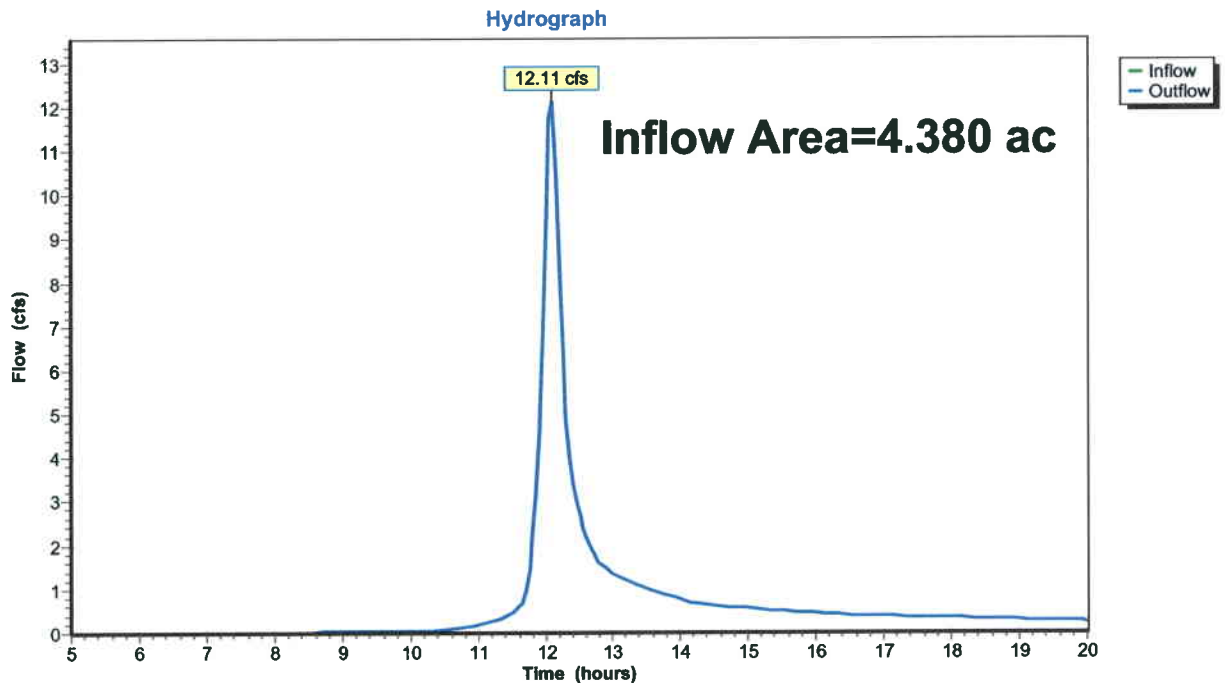
Inflow Area = 4.380 ac, 22.83% Impervious, Inflow Depth > 2.14" for 100-yr event

Inflow = 12.11 cfs @ 12.08 hrs, Volume= 0.779 af

Outflow = 12.11 cfs @ 12.08 hrs, Volume= 0.779 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 2R: WS #2B/C POA



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 61

**Summary for Pond 1P: Existing Wetlands-Reduced**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 2.80" for 100-yr event  
 Inflow = 30.02 cfs @ 12.13 hrs, Volume= 2.096 af  
**Outflow = 24.57 cfs @ 12.20 hrs, Volume= 2.026 af**, Atten= 18%, Lag= 4.2 min  
 Primary = 24.57 cfs @ 12.20 hrs, Volume= 2.026 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.89' @ 12.27 hrs Surf.Area= 26,313 sf Storage= 10,622 cf

Plug-Flow detention time= 23.3 min calculated for 2.019 af (96% of inflow)  
 Center-of-Mass det. time= 11.0 min ( 806.3 - 795.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.90'	21,366 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.90	0	0	0
992.00	539	27	27
992.50	12,019	3,140	3,166
993.00	30,390	10,602	13,769
993.25	30,390	7,598	21,366

Device	Routing	Invert	Outlet Devices
#1	Primary	992.42'	<b>Asymmetrical Weir, C= 3.27</b> Offset (feet) -26.27 -25.00 0.00 20.00 26.27 Height (feet) 0.58 0.13 0.00 0.13 0.58

**Primary OutFlow** Max=21.47 cfs @ 12.20 hrs HW=992.88' TW=992.82' (Dynamic Tailwater)  
 1=Asymmetrical Weir (Weir Controls 21.47 cfs @ 0.95 fps)

**Proposed**

Prepared by Microsoft

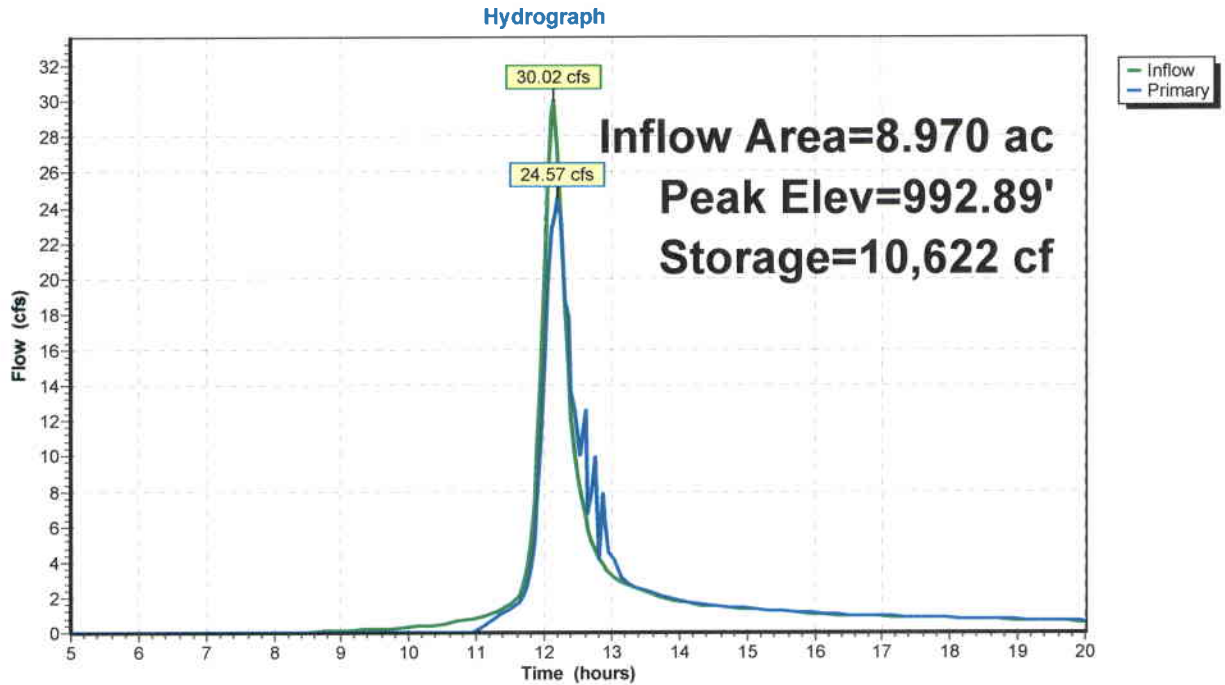
HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 62

**Pond 1P: Existing Wetlands-Reduced**



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 63

**Summary for Pond 2P: Box Culvert**

Inflow Area = 8.970 ac, 9.92% Impervious, Inflow Depth > 2.71" for 100-yr event  
 Inflow = 24.57 cfs @ 12.20 hrs, Volume= 2.026 af  
 Outflow = 23.70 cfs @ 12.20 hrs, Volume= 2.015 af, Atten= 4%, Lag= 0.0 min  
 Primary = 23.70 cfs @ 12.20 hrs, Volume= 2.015 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.84' @ 12.26 hrs Surf.Area= 4,150 sf Storage= 3,397 cf

Plug-Flow detention time= 5.5 min calculated for 2.015 af (99% of inflow)  
 Center-of-Mass det. time= 3.4 min ( 809.8 - 806.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	992.00'	4,045 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
992.00	3,730	0	0
992.50	4,150	1,970	1,970
993.00	4,150	2,075	4,045

Device	Routing	Invert	Outlet Devices
#1	Primary	992.00'	<b>120.0" W x 12.0" H Box Culvert</b> L= 150.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 992.00' / 0.00' S= 6.6133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 10.00 sf

**Primary OutFlow** Max=21.59 cfs @ 12.20 hrs HW=992.82' TW=992.31' (Dynamic Tailwater)

1=Culvert (Outlet Controls 21.59 cfs @ 3.51 fps)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

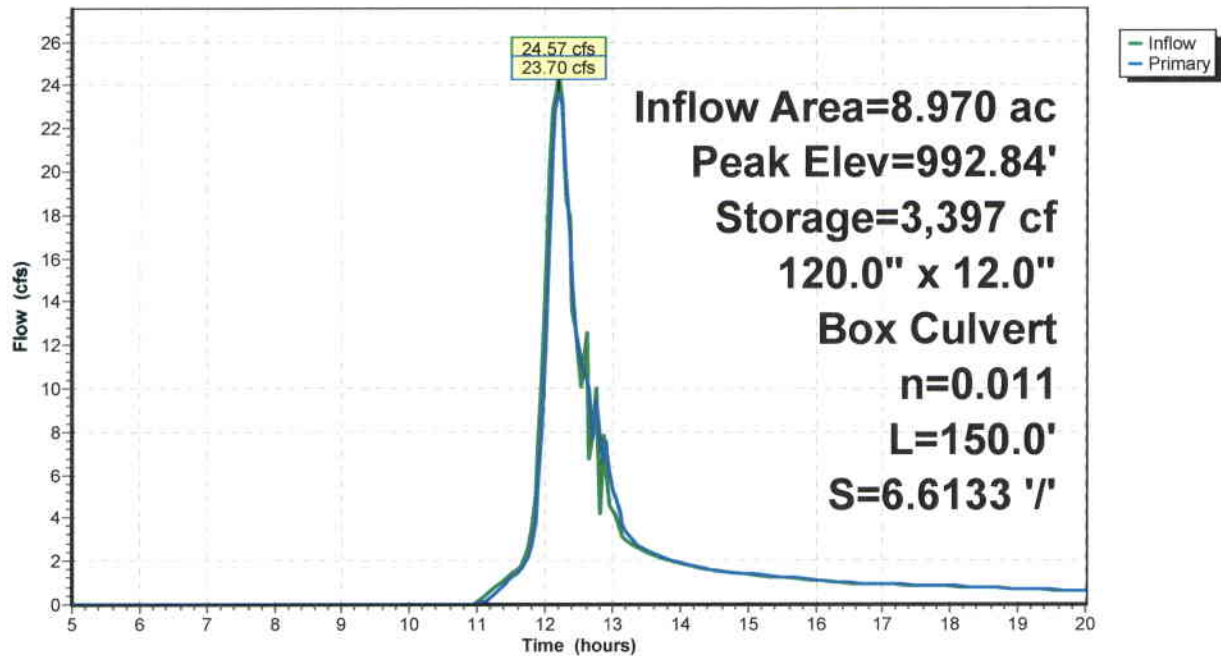
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 64

**Pond 2P: Box Culvert**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 65

**Summary for Pond 3P: Stormwater Wetland**

Inflow Area = 24.620 ac, 22.58% Impervious, Inflow Depth > 2.94" for 100-yr event  
 Inflow = 85.44 cfs @ 12.10 hrs, Volume= 6.042 af  
 Outflow = 27.46 cfs @ 12.45 hrs, Volume= 4.028 af, Atten= 68%, Lag= 21.2 min  
 Primary = 27.46 cfs @ 12.45 hrs, Volume= 4.028 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 992.61' @ 12.45 hrs Surf.Area= 49,288 sf Storage= 115,412 cf

Plug-Flow detention time= 122.4 min calculated for 4.028 af (67% of inflow)  
 Center-of-Mass det. time= 53.3 min ( 847.5 - 794.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	990.00'	162,573 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
990.00	39,265	0	0
993.00	50,800	135,098	135,098
993.50	59,100	27,475	162,573

Device	Routing	Invert	Outlet Devices
#1	Primary	990.00'	<b>18.0" Round Culvert x3 X 3.00</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 990.00' / 989.75' S= 0.0050 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	990.00'	<b>3.0" Vert. Orificex2 X 2.00</b> C= 0.600
#3	Device 1	992.00'	<b>36.0" x 36.0" Horiz. Grate#1 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#4	Device 1	992.00'	<b>36.0" x 72.0" Horiz. Grate#2 X 2.00</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	993.00'	<b>75.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=27.46 cfs @ 12.45 hrs HW=992.61' TW=0.00' (Dynamic Tailwater)

- 1=Culvert x3 (Inlet Controls 27.46 cfs @ 5.18 fps)
- 2=Orificex2 (Passes < 0.74 cfs potential flow)
- 3=Grate#1 (Passes < 37.07 cfs potential flow)
- 4=Grate#2 (Passes < 55.60 cfs potential flow)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=990.00' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

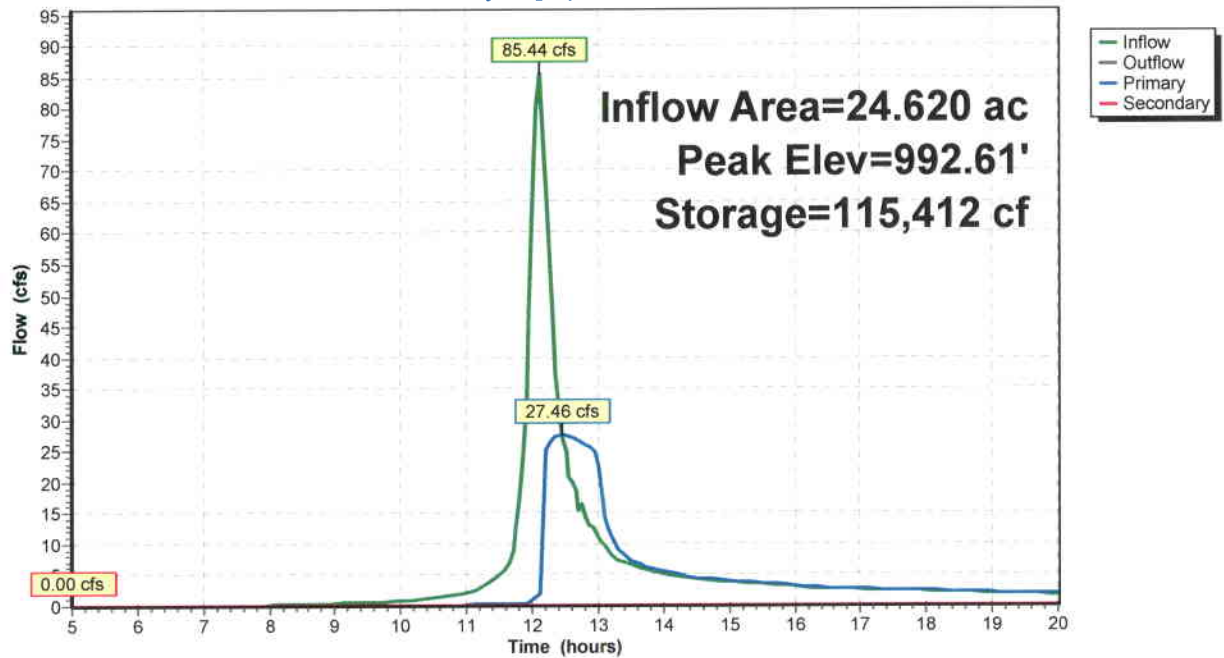
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 66

**Pond 3P: Stormwater Wetland**

Hydrograph





**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 67

**Summary for Pond 4P: Wetland #2**

Inflow Area = 1.000 ac, 8.00% Impervious, Inflow Depth > 1.35" for 100-yr event  
 Inflow = 1.87 cfs @ 12.07 hrs, Volume= 0.112 af  
 Outflow = 0.15 cfs @ 13.46 hrs, Volume= 0.086 af, Atten= 92%, Lag= 83.1 min  
 Primary = 0.15 cfs @ 13.46 hrs, Volume= 0.086 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 991.54' @ 13.46 hrs Surf.Area= 4,602 sf Storage= 2,360 cf

Plug-Flow detention time= 186.9 min calculated for 0.086 af (76% of inflow)

Center-of-Mass det. time= 121.4 min ( 944.6 - 823.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	991.00'	10,083 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
991.00	4,100	0	0
992.00	5,025	4,563	4,563
993.00	6,015	5,520	10,083

Device	Routing	Invert	Outlet Devices
#1	Primary	991.00'	<b>8.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 991.00' / 990.50' S= 0.0100 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	991.00'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	991.75'	<b>36.0" x 36.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	993.00'	<b>100.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.15 cfs @ 13.46 hrs HW=991.54' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.15 cfs of 0.60 cfs potential flow)

2=Orifice (Orifice Controls 0.15 cfs @ 3.11 fps)

3=Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=991.00' (Free Discharge)

4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

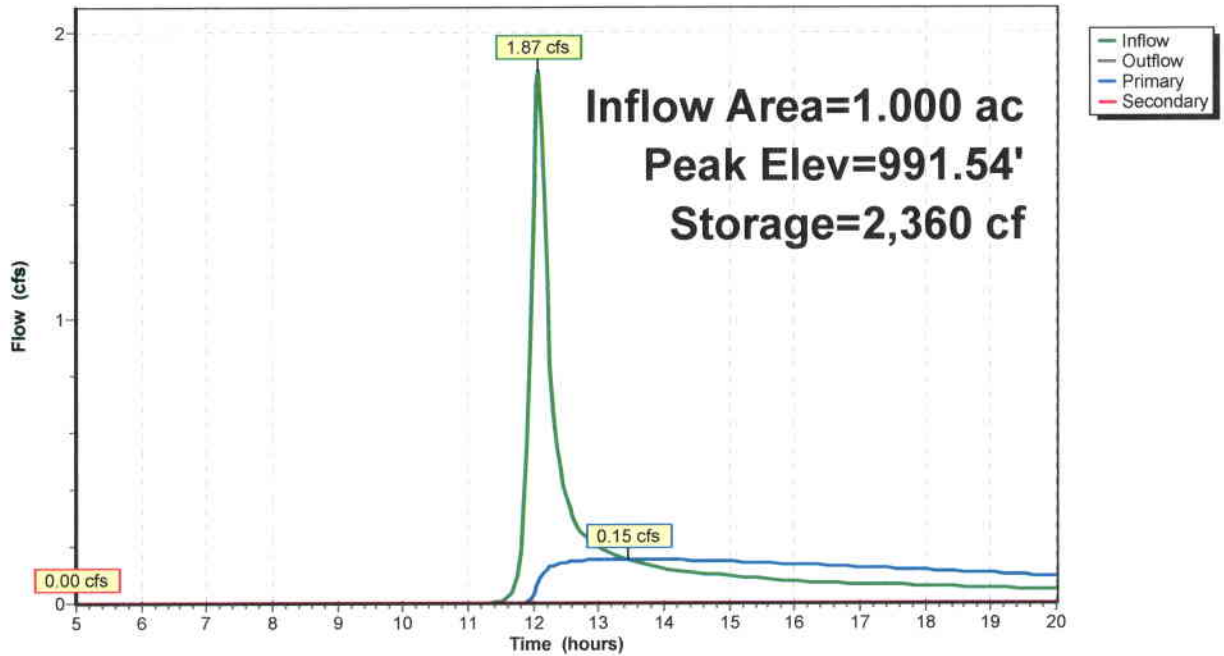
Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 68

**Pond 4P: Wetland #2**

Hydrograph



**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 69

**Summary for Pond 5P: Underground Detention**

Inflow Area = 0.170 ac, 88.24% Impervious, Inflow Depth > 4.69" for 100-yr event  
 Inflow = 1.31 cfs @ 11.96 hrs, Volume= 0.067 af  
 Outflow = 0.30 cfs @ 12.13 hrs, Volume= 0.066 af, Atten= 77%, Lag= 9.8 min  
 Primary = 0.30 cfs @ 12.13 hrs, Volume= 0.066 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 982.34' @ 12.13 hrs Surf.Area= 0.013 ac Storage= 0.022 af

Plug-Flow detention time= 29.1 min calculated for 0.066 af (100% of inflow)  
 Center-of-Mass det. time= 27.0 min ( 766.9 - 739.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	980.55'	0.029 af	<b>30.0" Round Pipe Storage x 2</b> L= 130.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	980.55'	<b>15.0" Round Culvert</b> L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 980.55' / 979.30' S= 0.0156 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	980.55'	<b>3.0" Vert. Orifice</b> C= 0.600
#3	Device 1	982.95'	<b>2.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.30 cfs @ 12.13 hrs HW=982.33' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 0.30 cfs of 5.02 cfs potential flow)  
 2=Orifice (Orifice Controls 0.30 cfs @ 6.20 fps)  
 3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Proposed**

Prepared by Microsoft

HydroCAD® 10.00-16 s/n 05659 © 2015 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.73"

Printed 12/14/2017

Page 70

**Pond 5P: Underground Detention**

